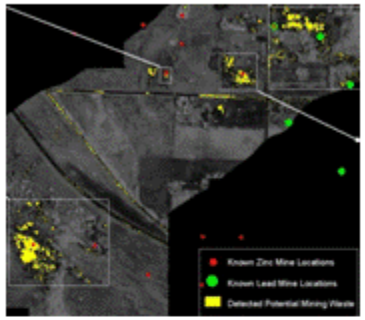
Missouri
Department of
Natural Resources

MODNR
ARCHER
Hyperspectral Imagery for Contamination Related Analysis



"Operationalize an available technology to support planning and focus limited resources."

May 2009

MISSOURI DEPARTMENT OF NATURAL RESOURCES (MODNR)
Nick Carbone, Shawn Muenks

Missouri Department of Natural Resources

Overview

- MODNR Projects
  - 2005 Pilot Project
    - Emergency Response
    - Landfill Seeps
    - Mine Waste
    - Other Sites Collected
  - 2008 Project
    - Mine Waste
    - Airborne Deposition
    - River Sediment
  - 2009 Project
    - Vegetation Stress
    - Mine Drainage
    - Mine Shafts
    - Airborne Deposition

2005
HSI PILOT PROJECT

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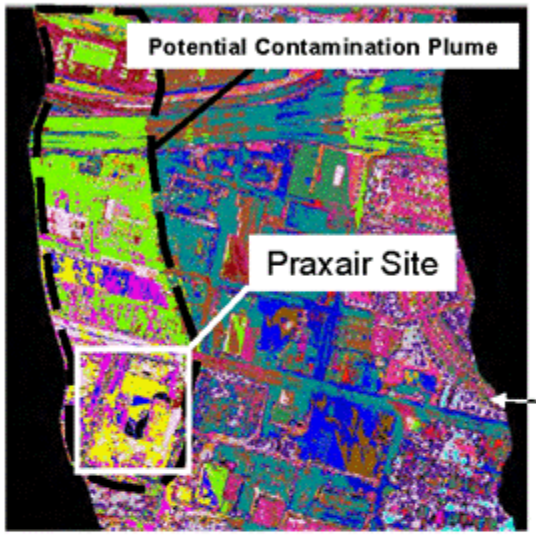
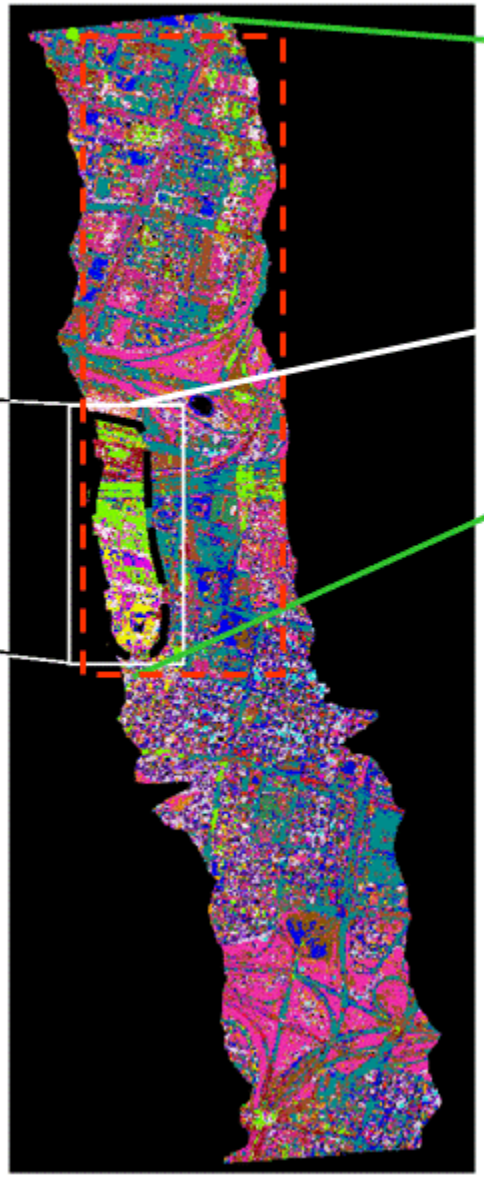
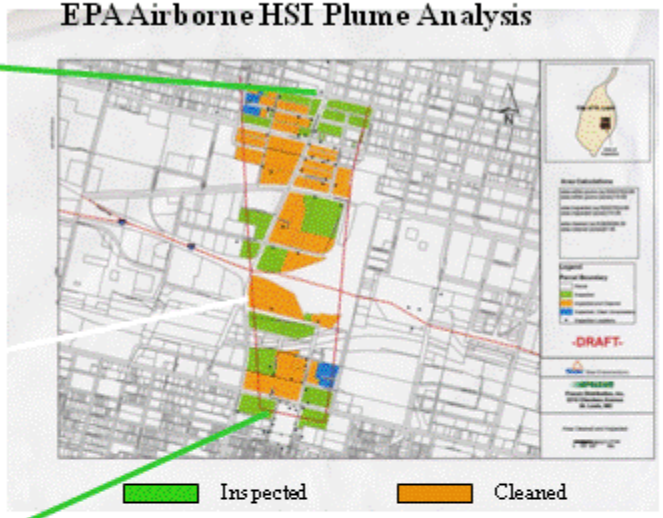
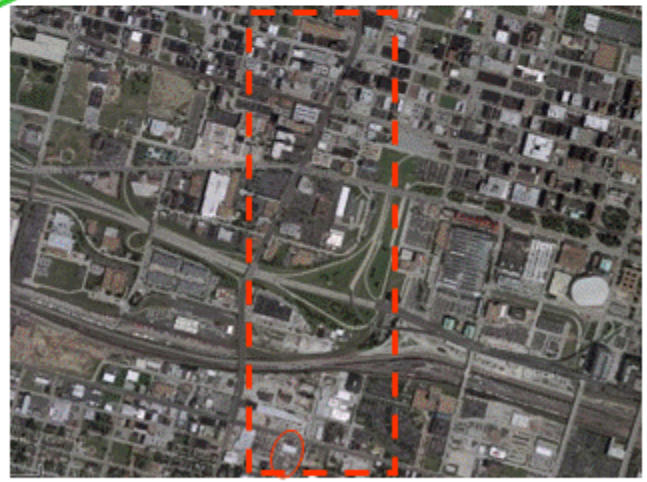
Praxair Fire Endmember Analysis









- Determine extent of dispersed debris from the fire.
- Characterize contamination/debris where feasible.

Asbestos was major concern.

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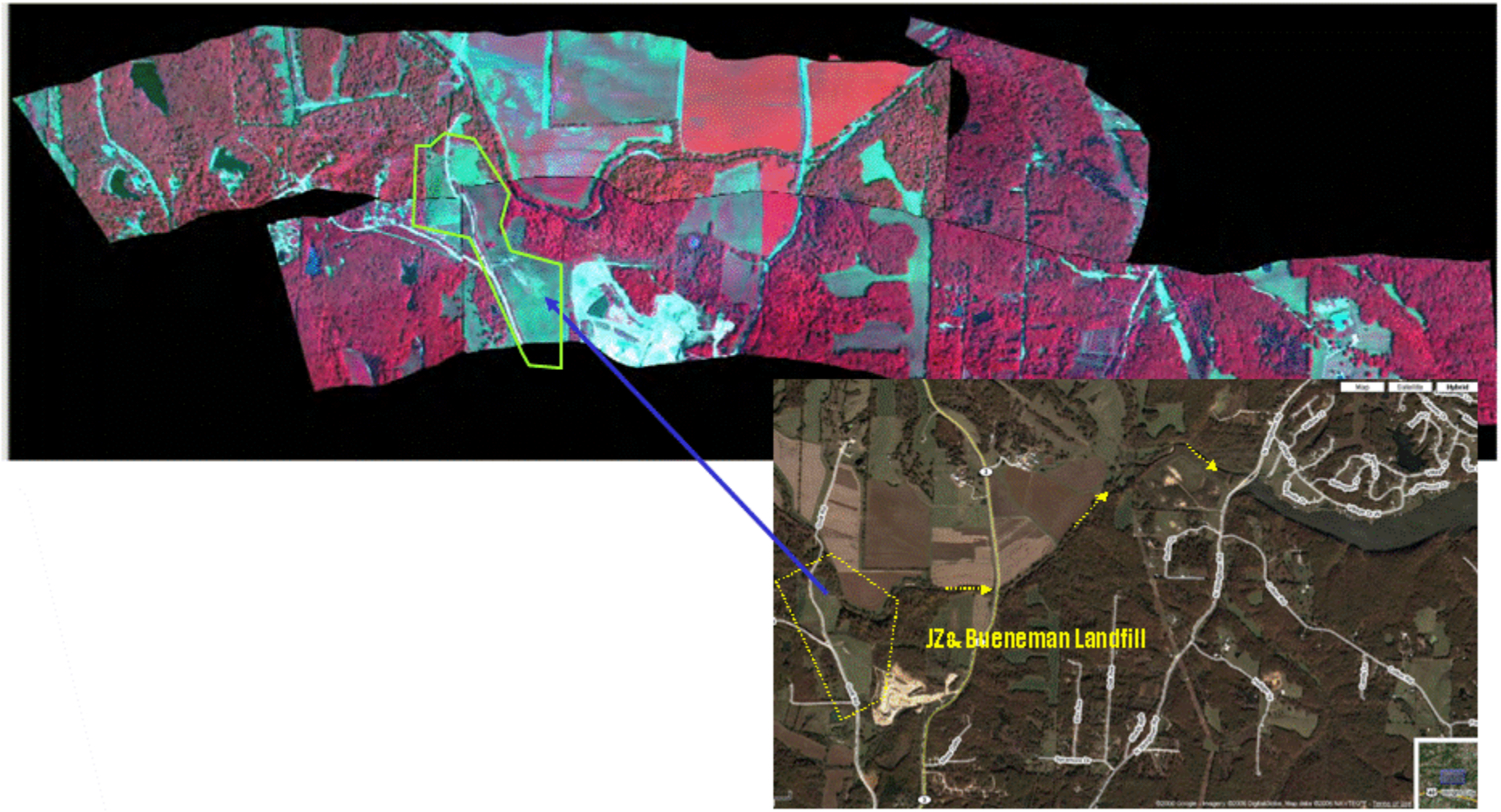
JZ and Bueneman Landfills Monitor Closed/Abandoned Sites



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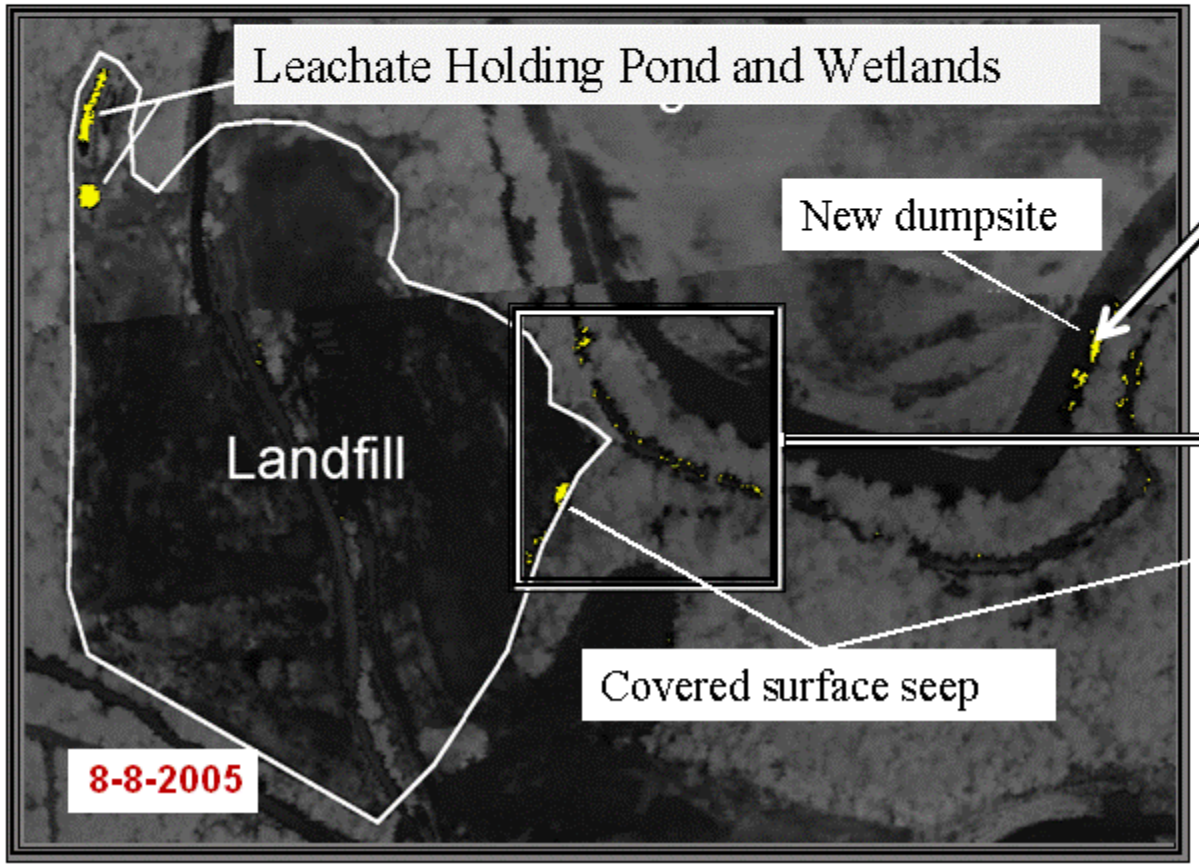
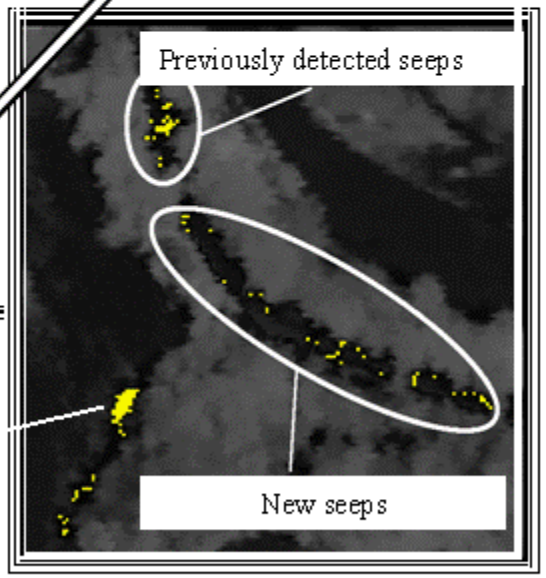
Landfill Seeps & Drainage

- **Leachate pond used for spectral signature of contaminants draining from the landfill.**
- **HSI analysis identified:**
  - Previously covered surface seep that has reappeared.
  - Previously detected and new seeps in the creep.
  - Newly discovered dumpsite across from the landfill.





JZ and Bueneman Landfill

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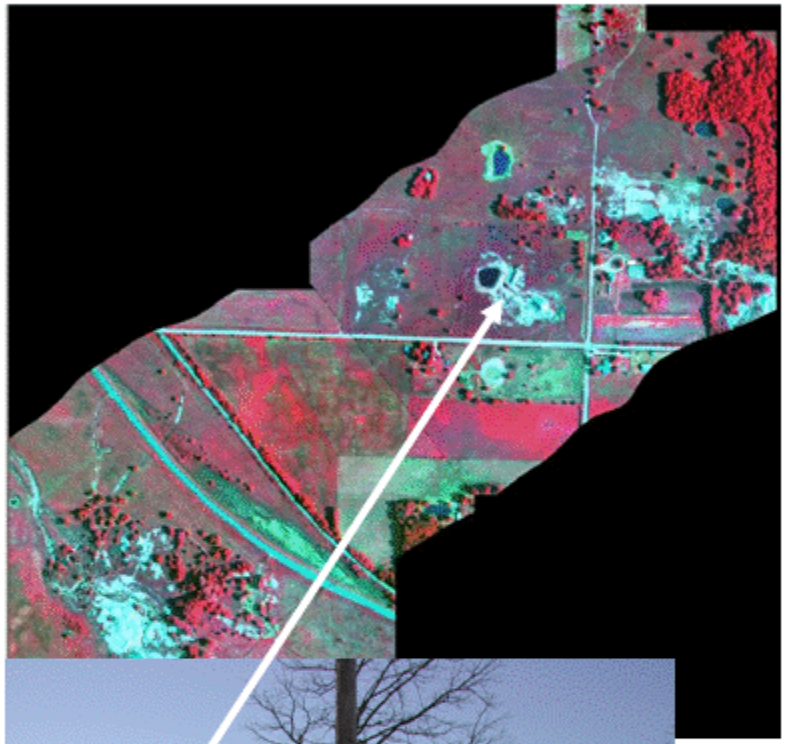
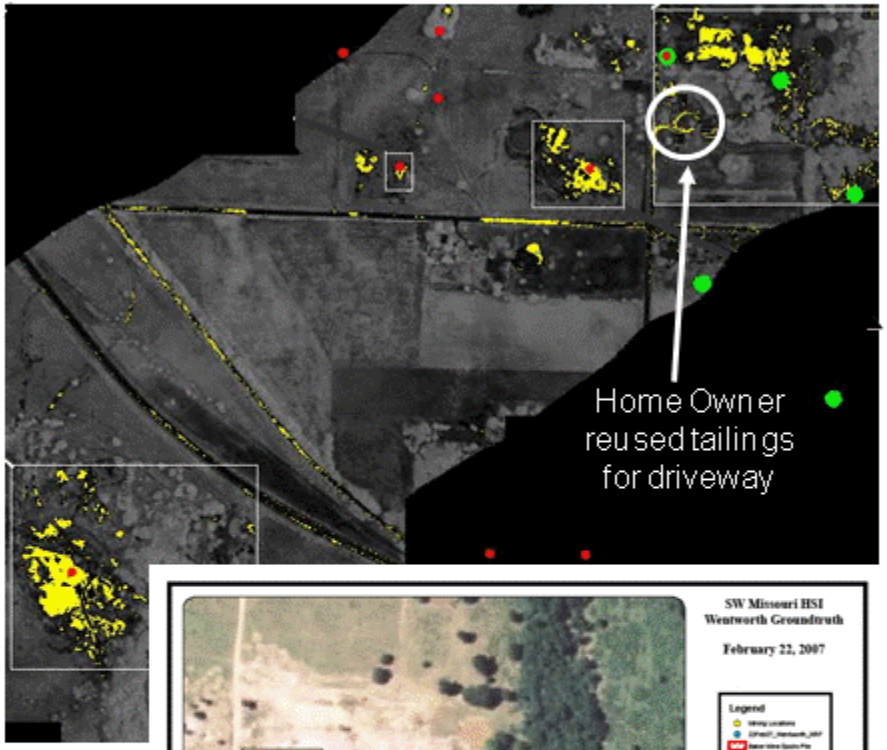
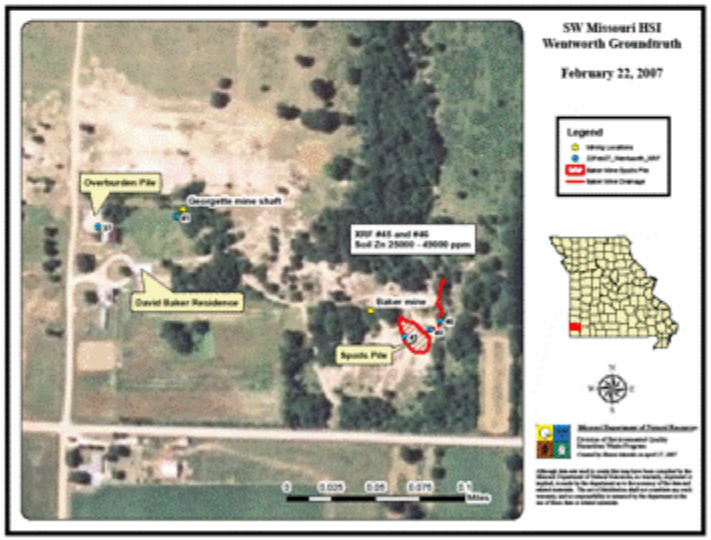
Wentworth Cadmium Mine







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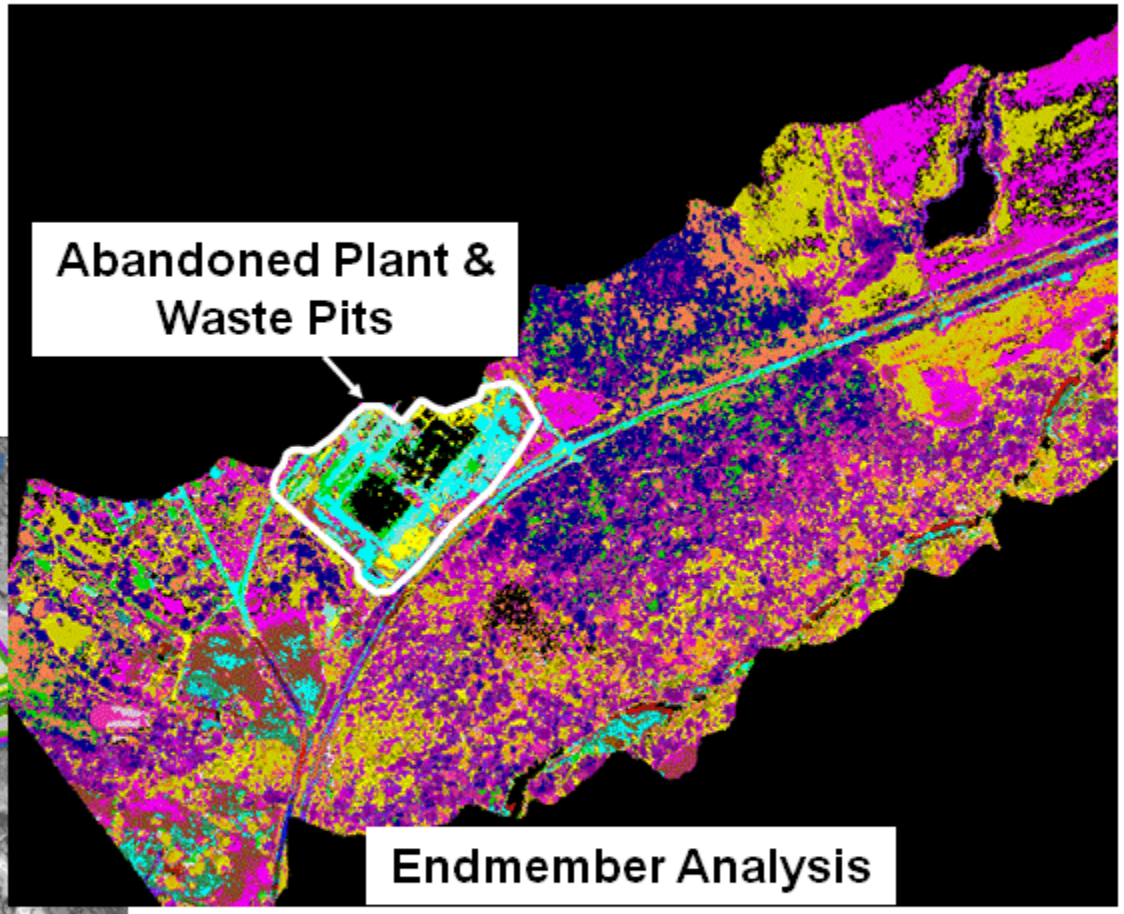
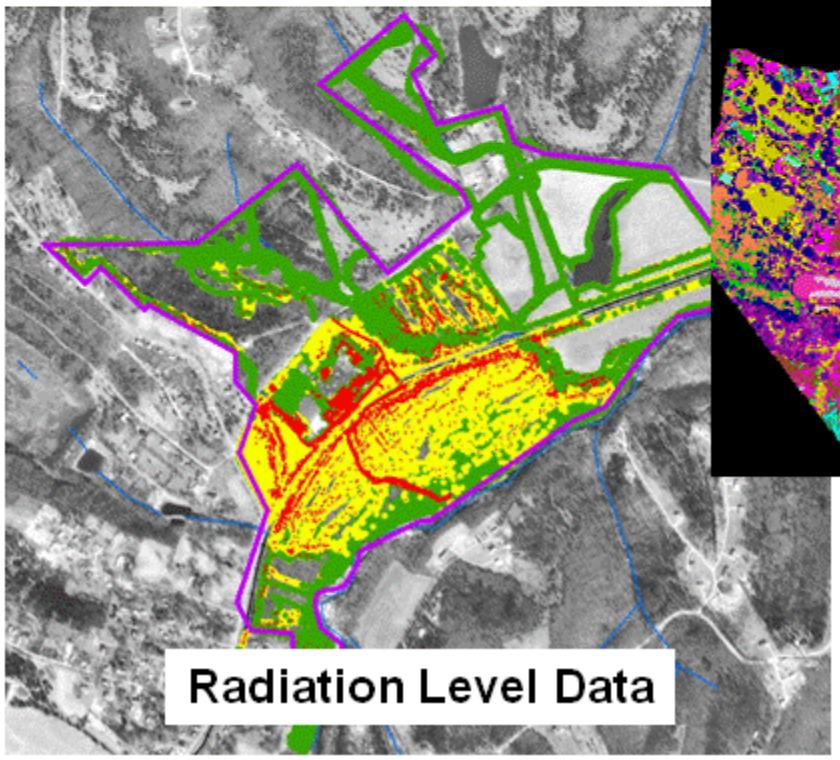
Hematite Radioactive Site





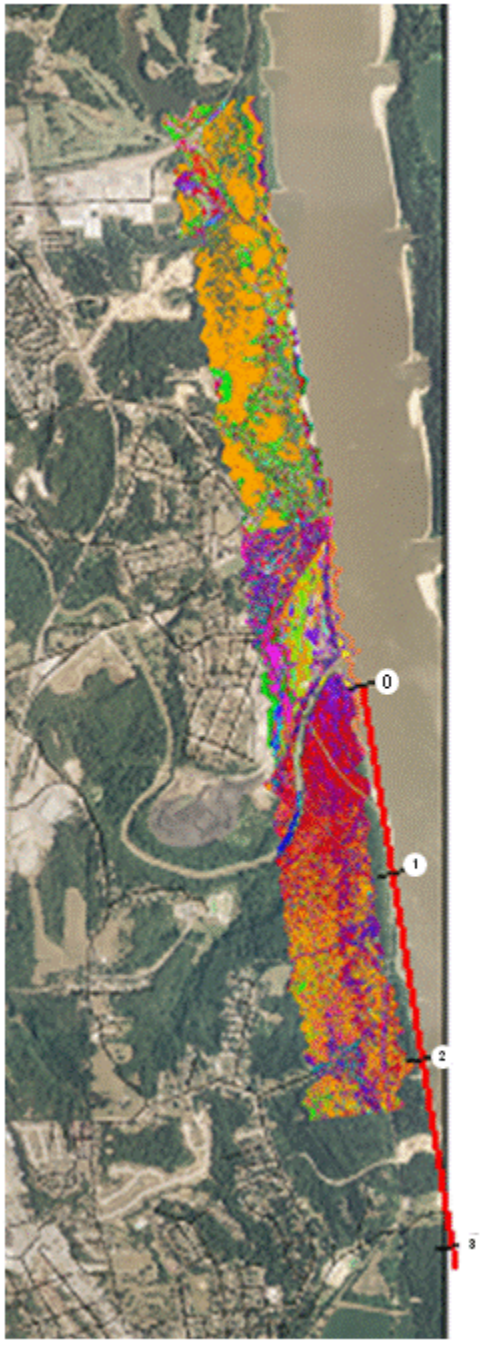
2008
HSI PROJECT

Missouri Department of Natural Resources

Sycamore – Soil Study

Kucera Study "Lead Contamination of Sycamore and Soil from Lead Mining and Smelting Operations in Eastern Missouri" 1980

- Lead levels of soil and vegetation decreased to background at distances from 1.6 to 4.8 km.
- Prevailing winds from the north & south most likely account for the large soil levels encountered at 8.0 km in these directions. Buchauer (1973) reports that a distance of 39 km in the direction of the prevailing wind was necessary before she could observe background levels of lead.
- Lead concentration PPM for St. Joe (Herculaneum) Smelter
  - Soil South of Smelter
    - 62,000 @ 0.3 km (Nitric acid-extractable)
    - ~ 200 @ 0.6 km
    - ~ 800 @ 2.0 km
    - ~ 700 @ 4.0 km
  - Soil North of Smelter
    - 8,250 @ 0.3 km
    - ~ 100 @ 0.6 km
    - ~ 200 @ 2.0 km
    - ~ 90 @ 4.0 km
  - Soil West of Smelter
    - 400 @ 0.6 km
    - ~ 100 @ 2.0 km
    - ~ 30 @ 5.0 km
    - ~ 60 @ 10.0 km



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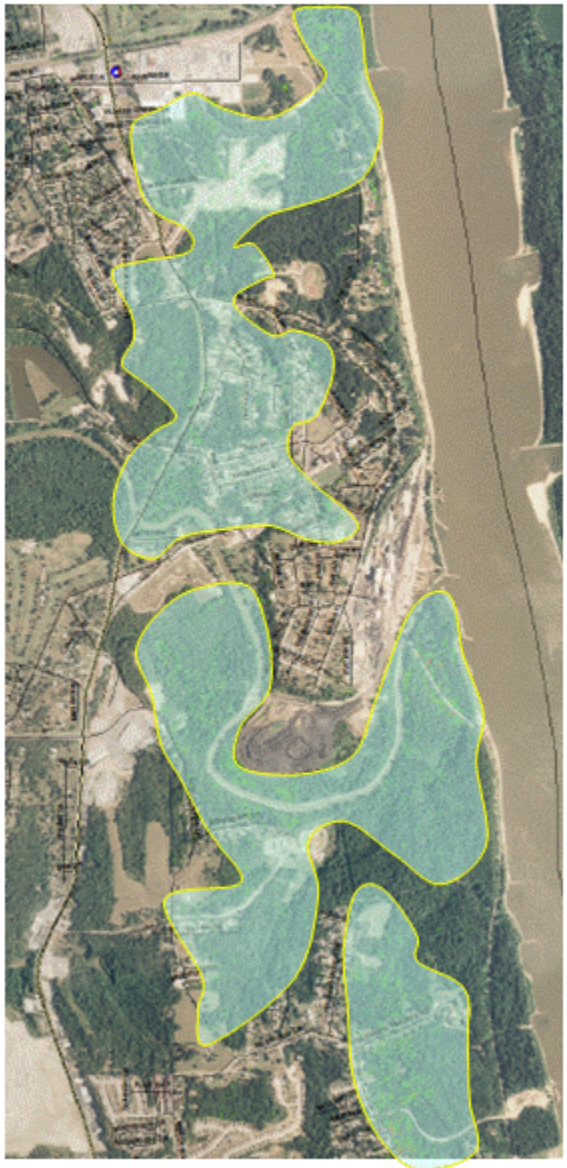
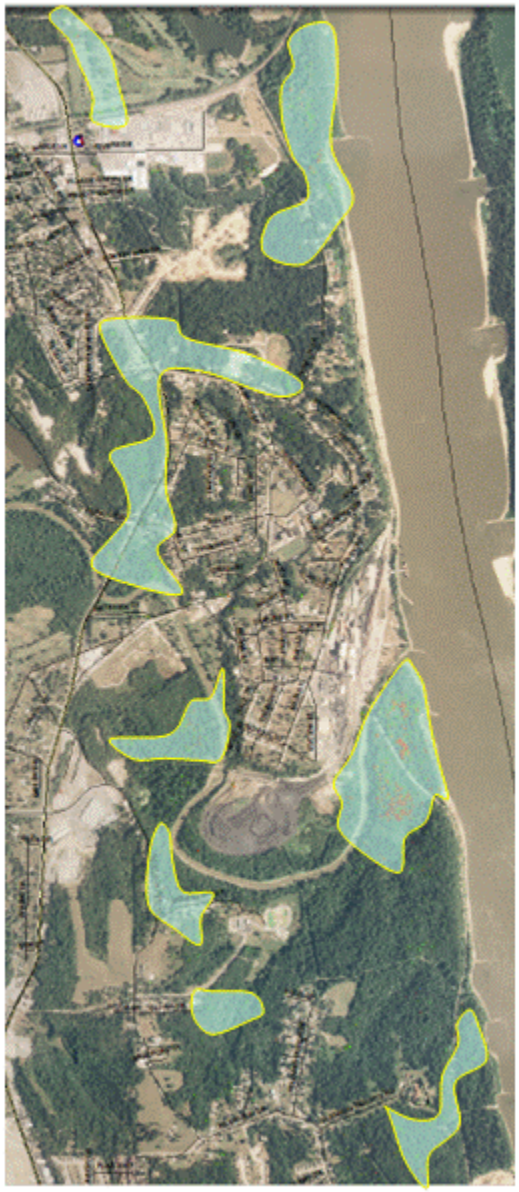
SAM Analysis Deciduous & Conifer South



HTD1 – Deciduous



HTC1 – Cedar

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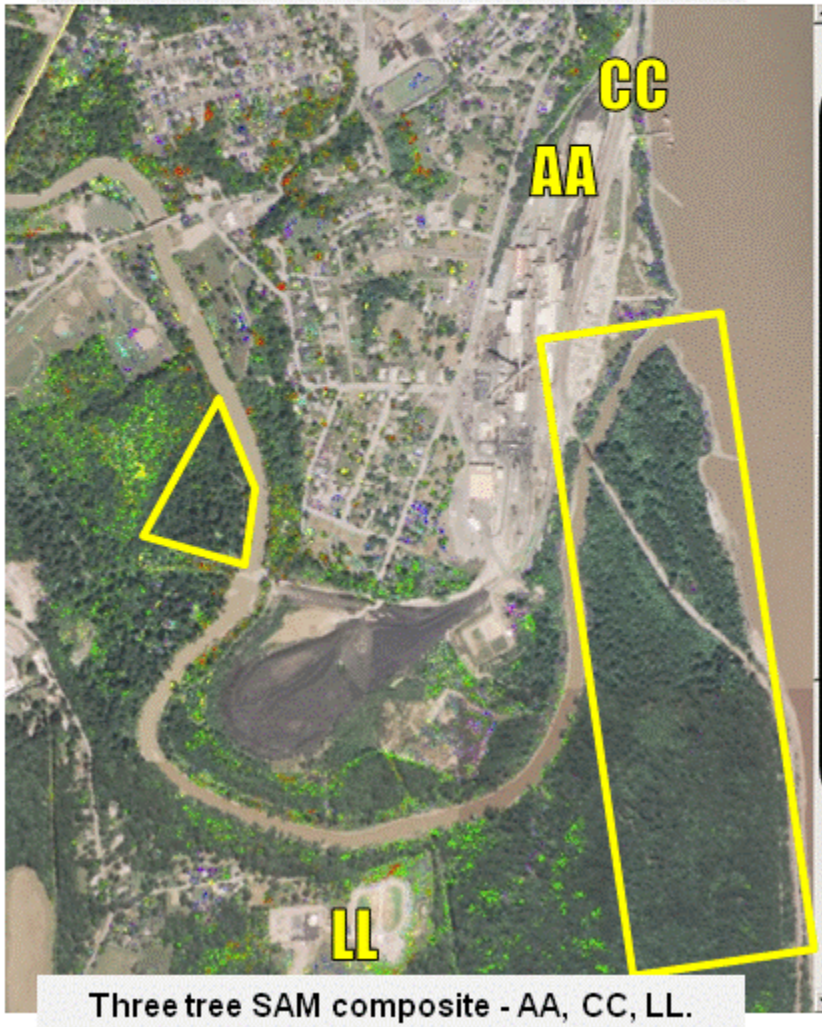
Second
SAM Analysis – Conifer

(Trees selected from Field Survey)

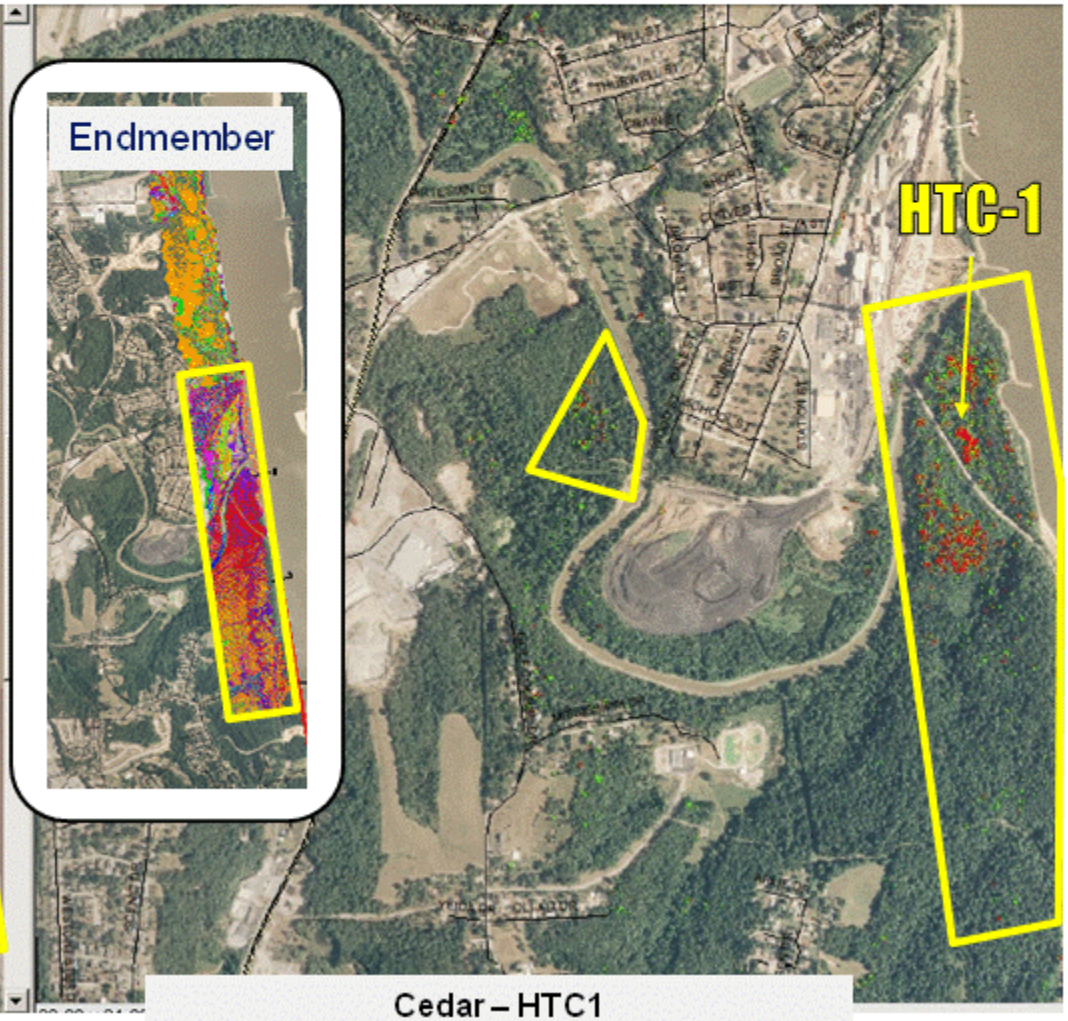
AA – Cedar, CC – Pine, LL - Cedar



Three tree SAM composite - AA, CC, LL.

First
SAM Analysis – HTC1

(Cedar selected from Imagery)



Cedar – HTC1

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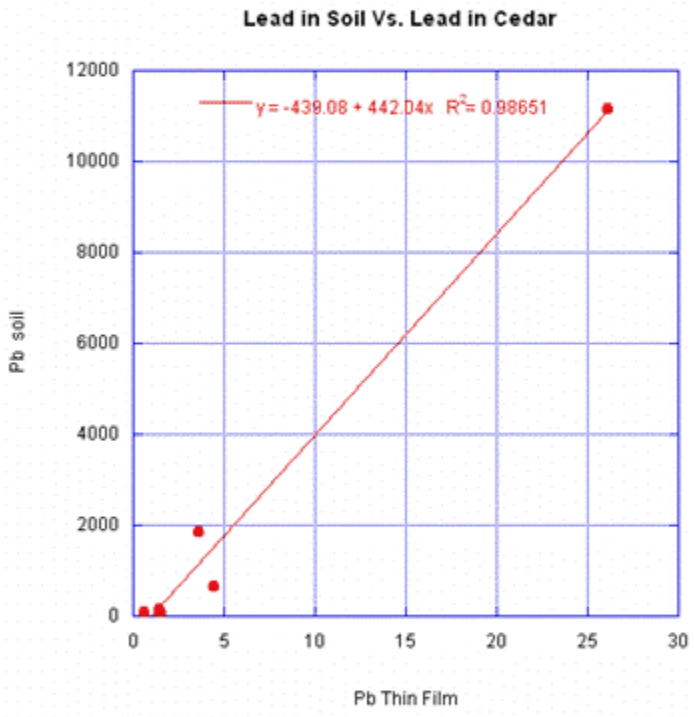
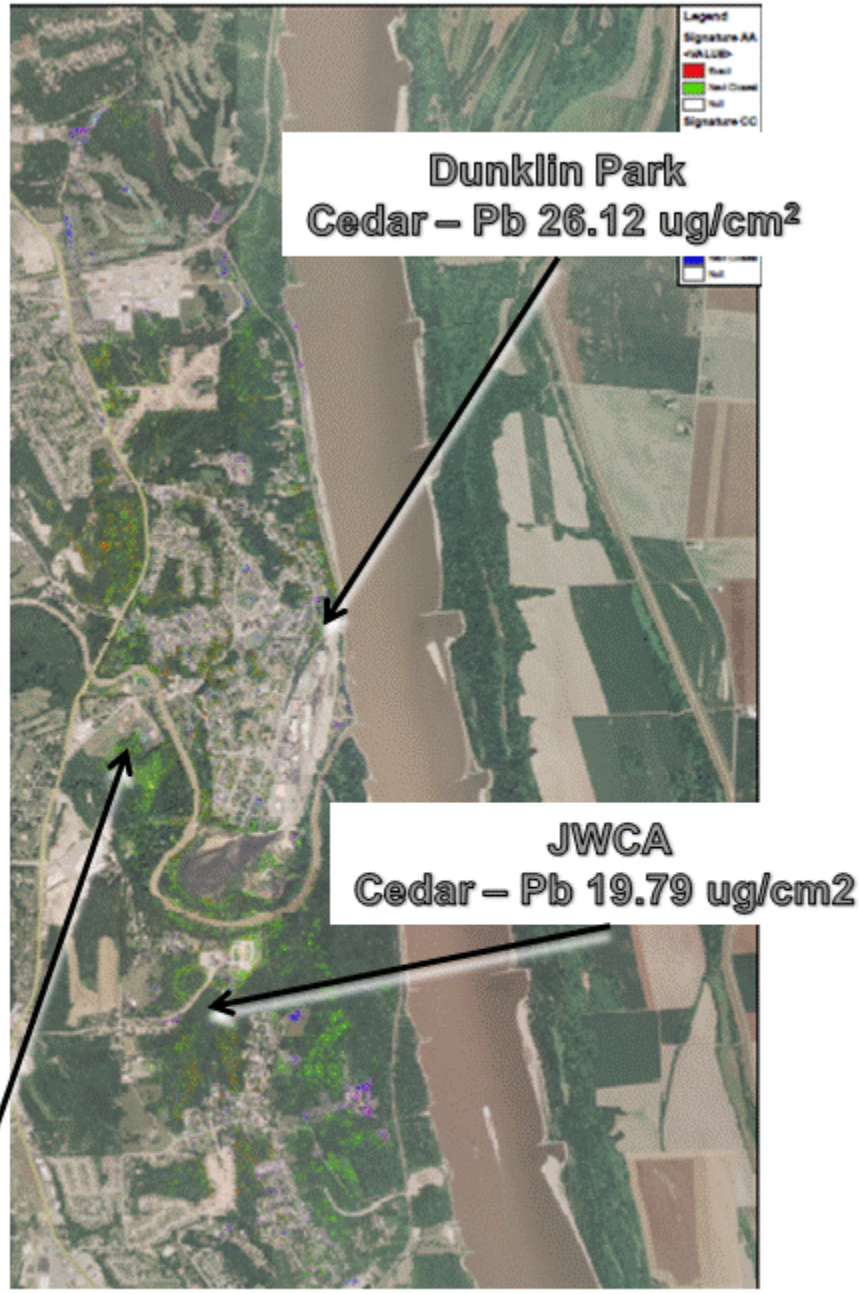
Field Survey





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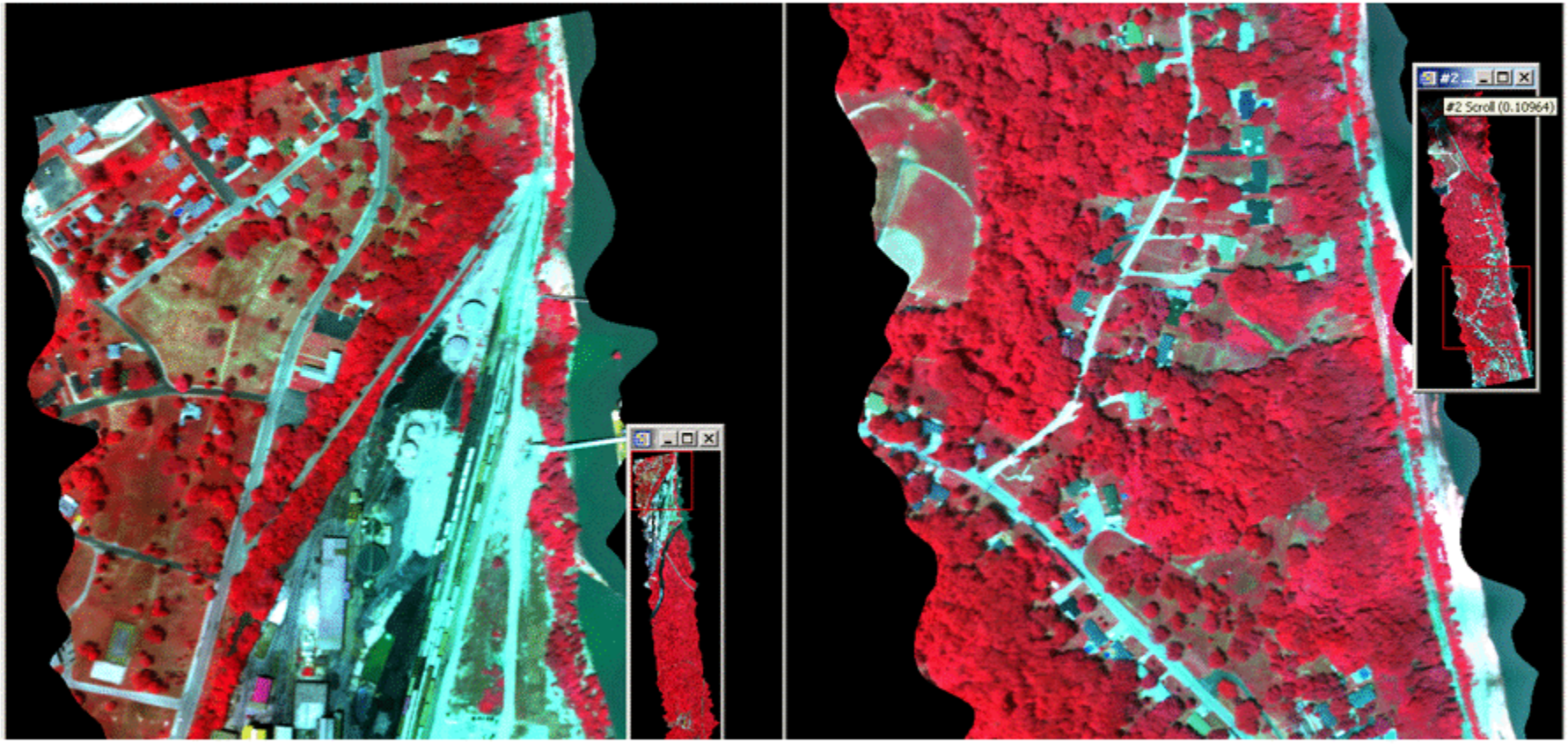
Herculaneum Vegetation Stress



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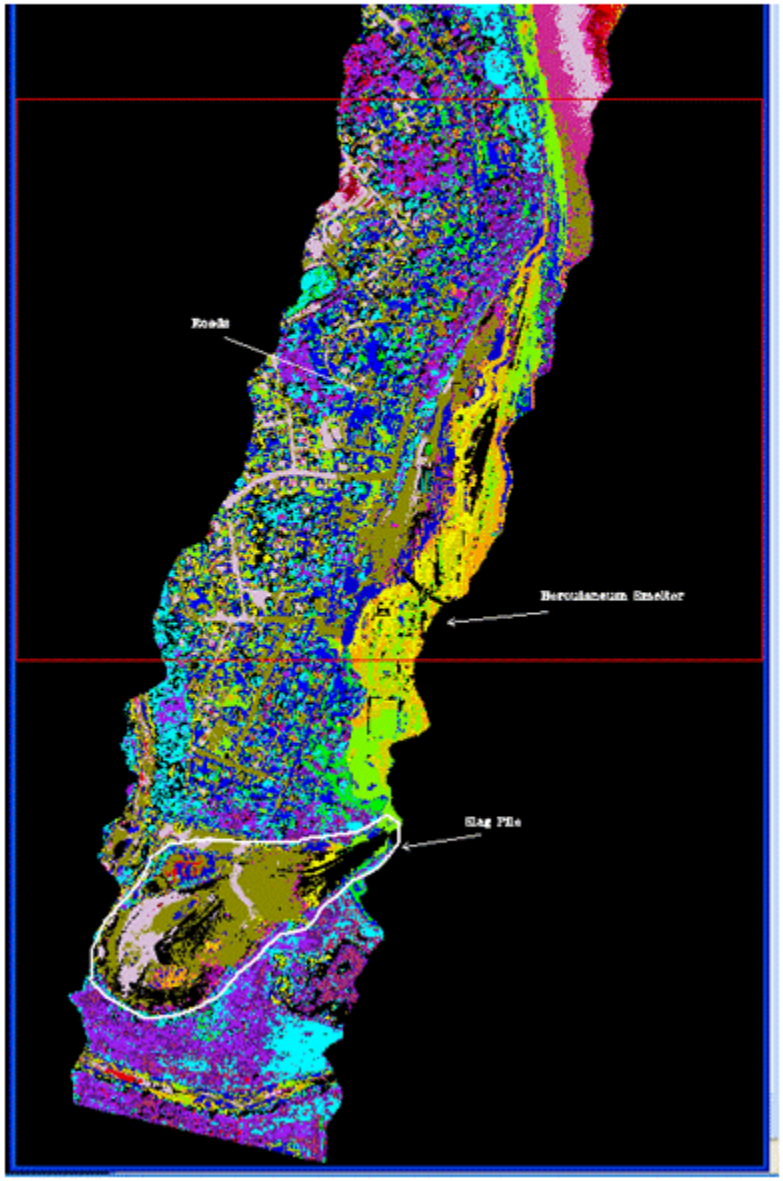
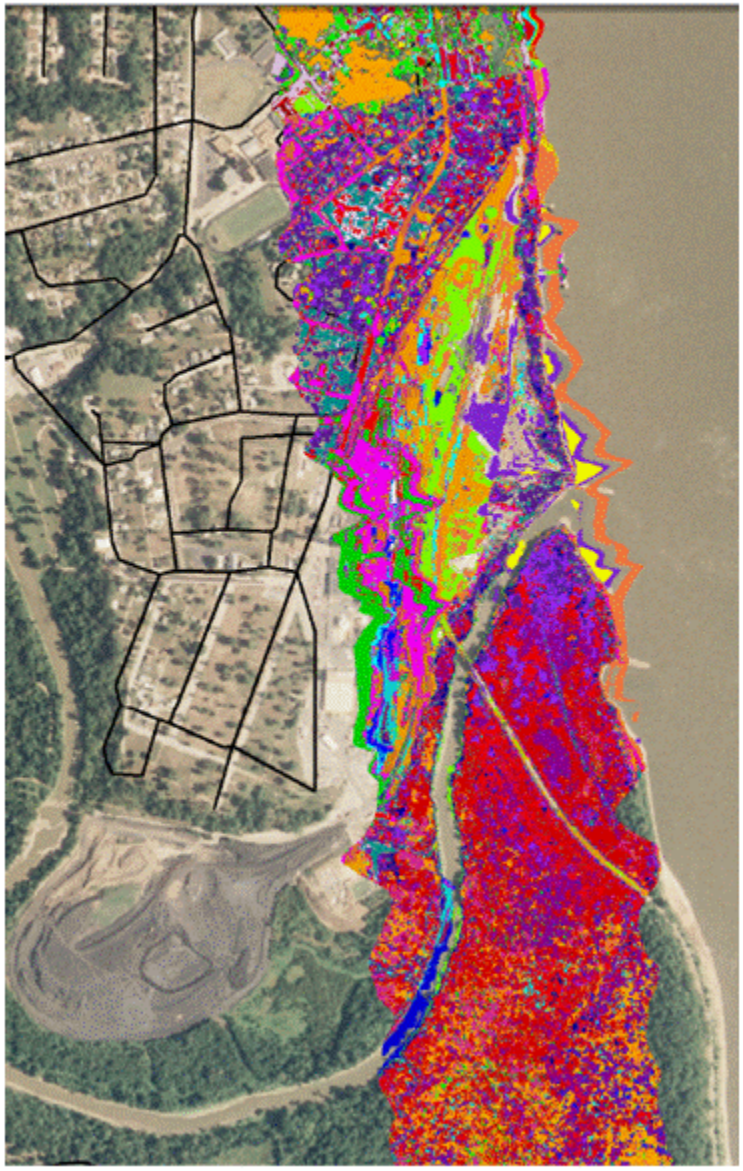
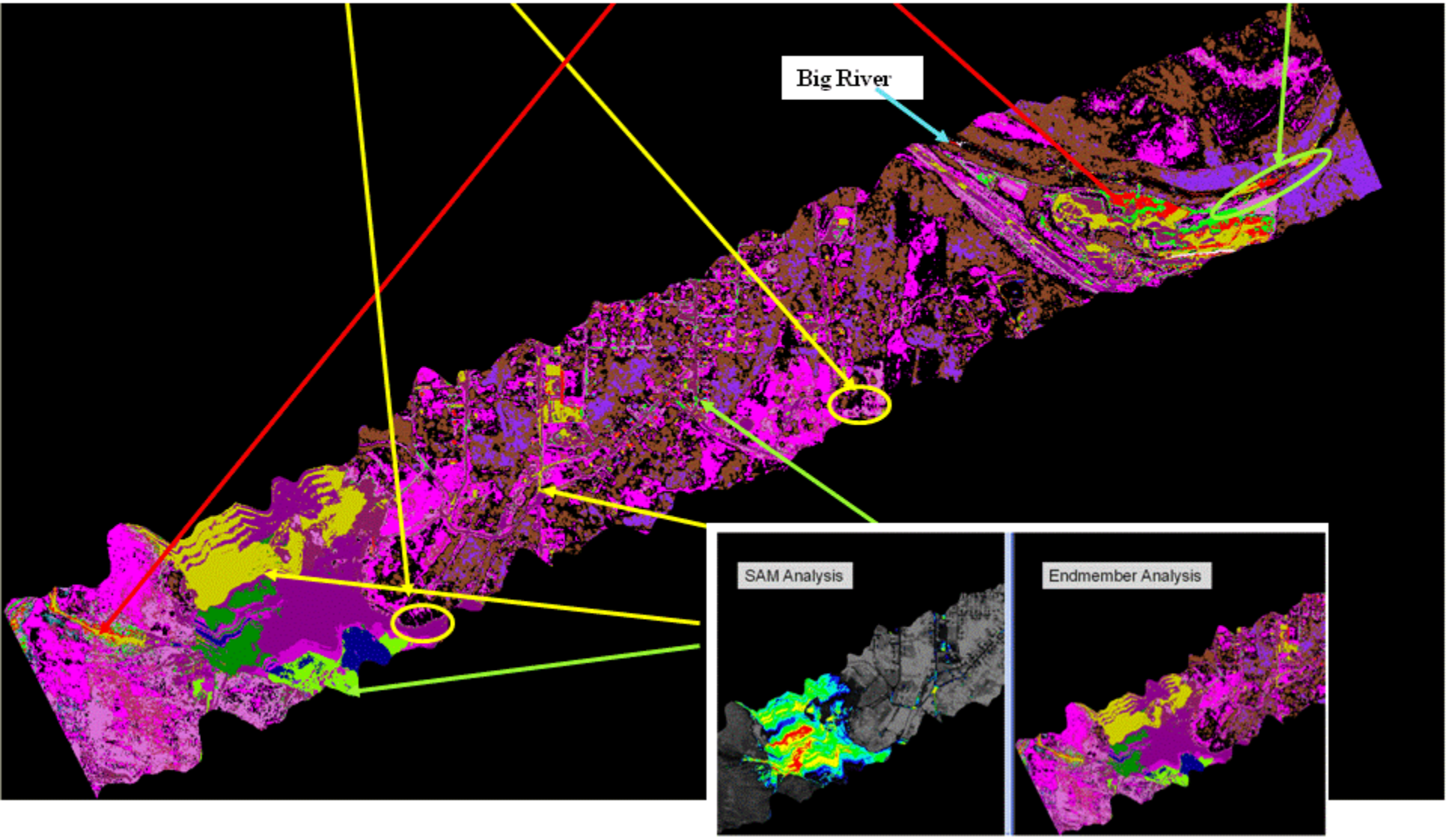
Herculaneum 2005 & 2007





Leadwood Endmember Analysis



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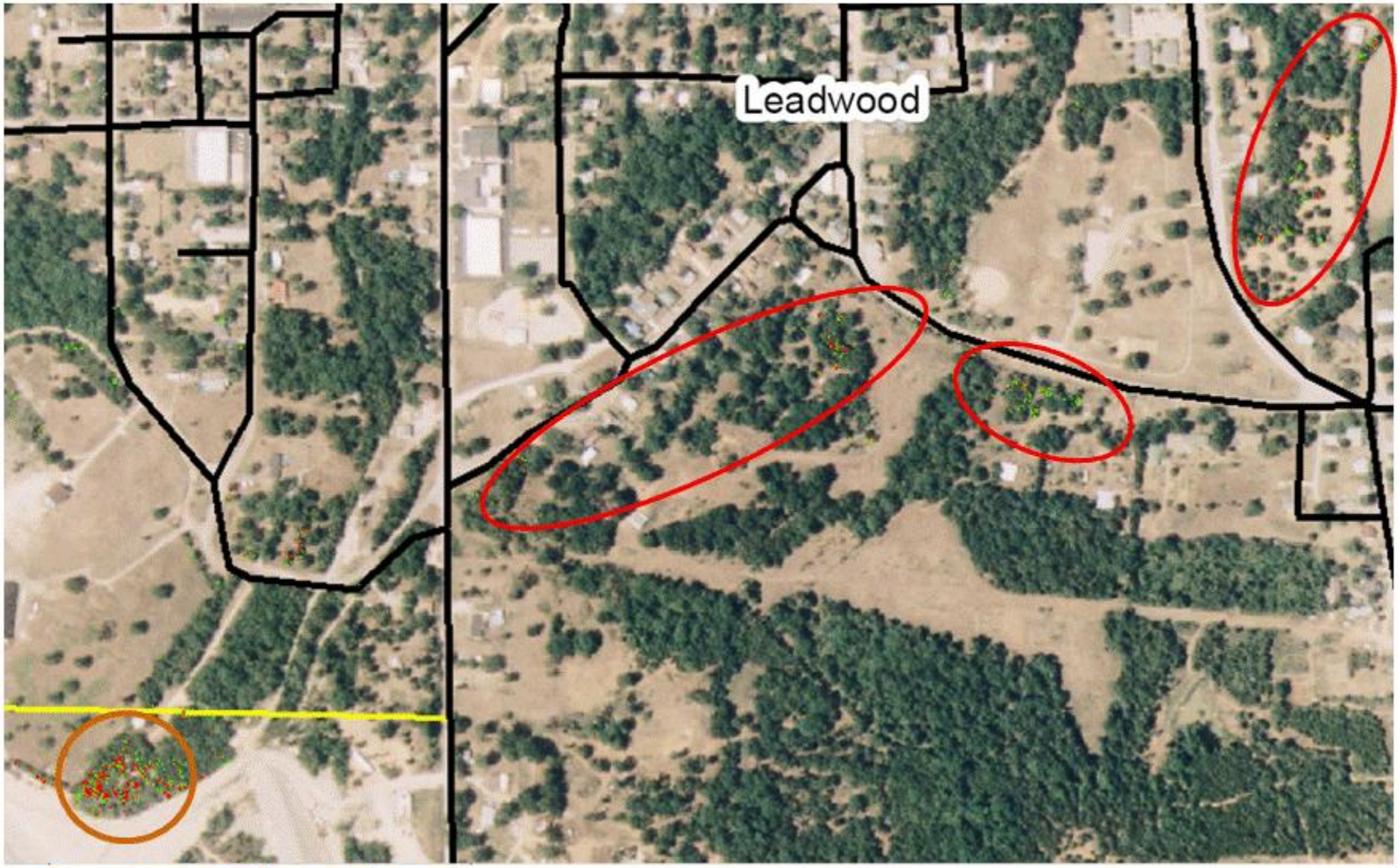
Leadwood SAM Analysis – Cedar



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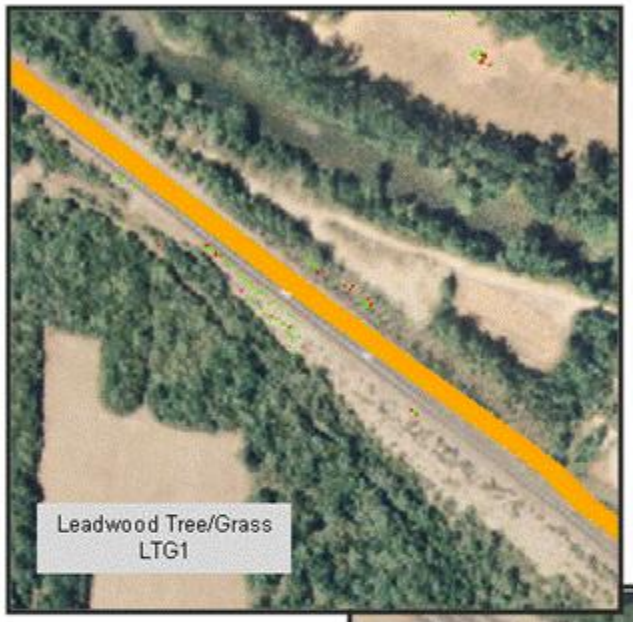
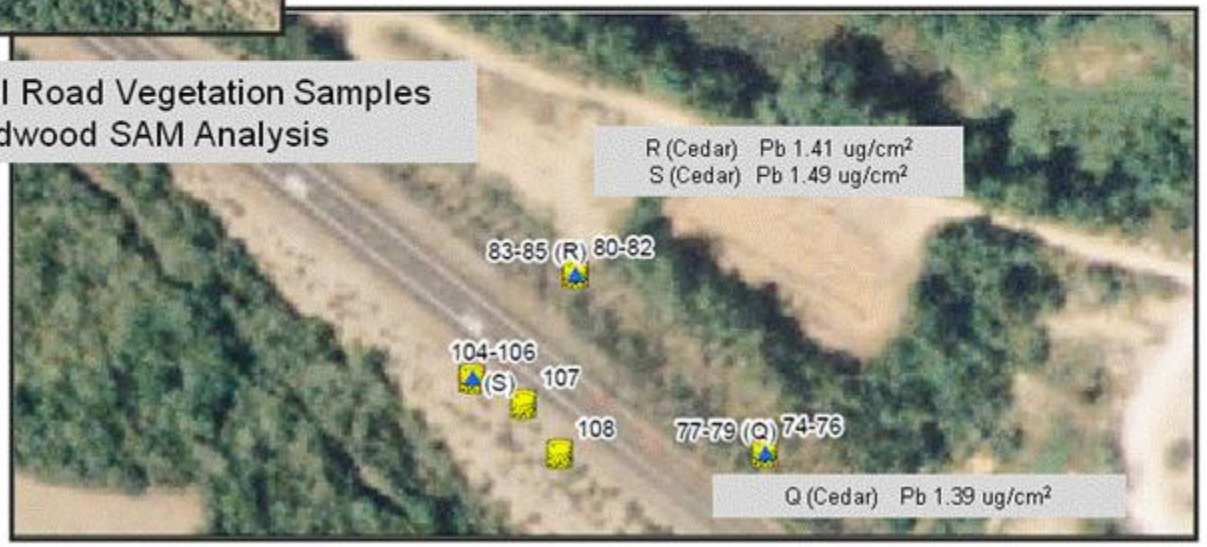
Leadwood Haul Road - Cedar



Leadwood Haul Road Vegetation Samples and Leadwood SAM Analysis



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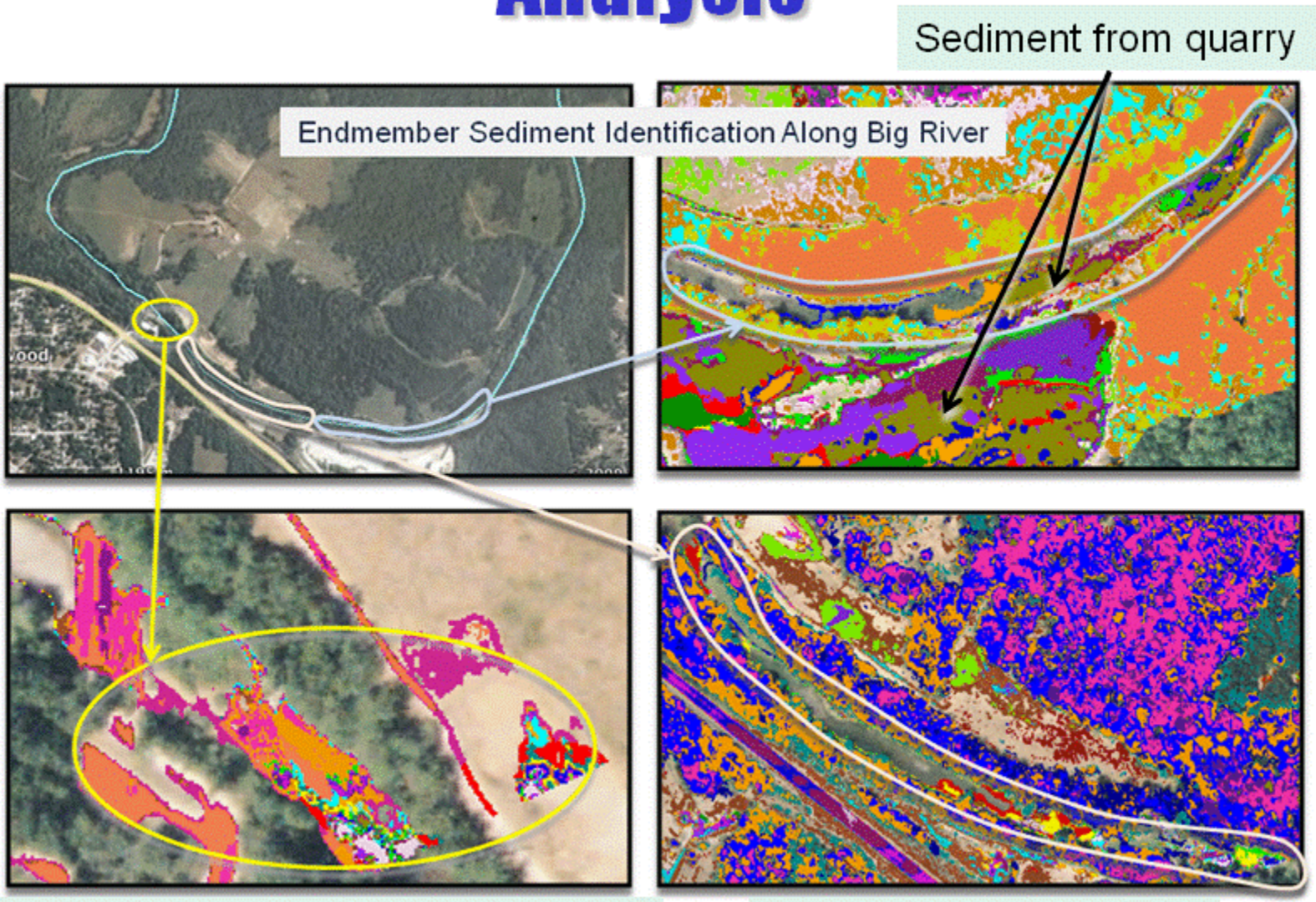
Big River Sediment Endmember Analysis



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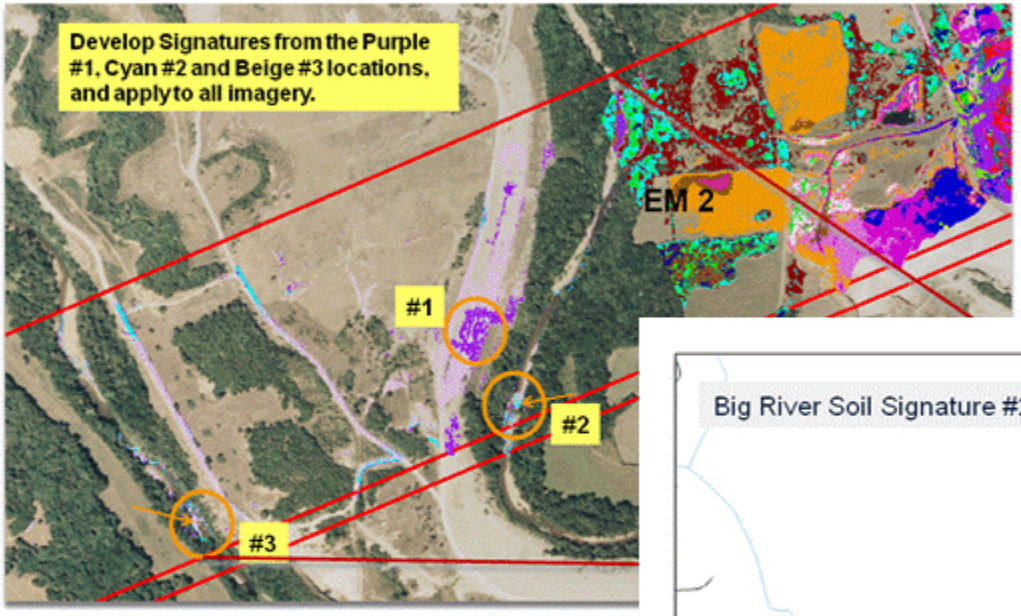
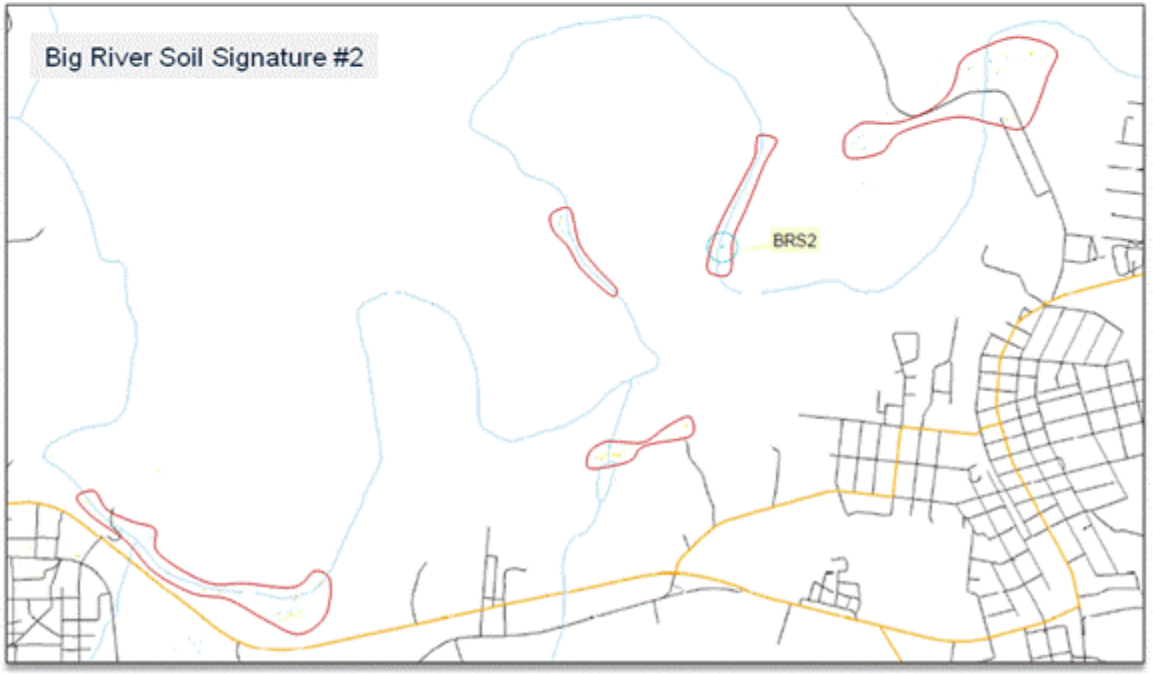
Big River Sediment and Tailings





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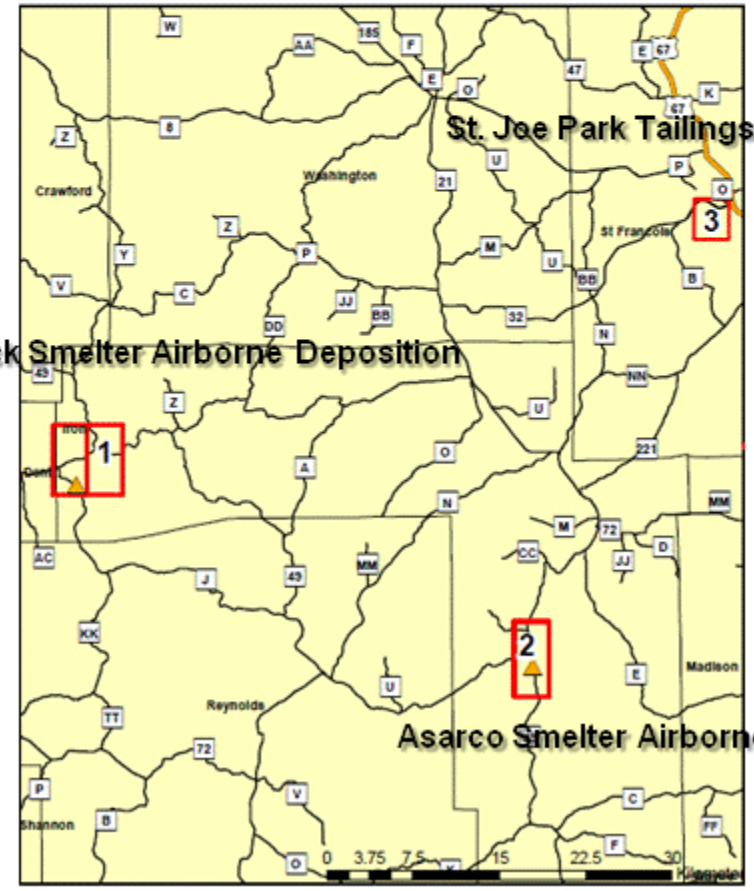
2009 MODNR ON-GOING PROJECTS

MMII Closed Site Monitoring



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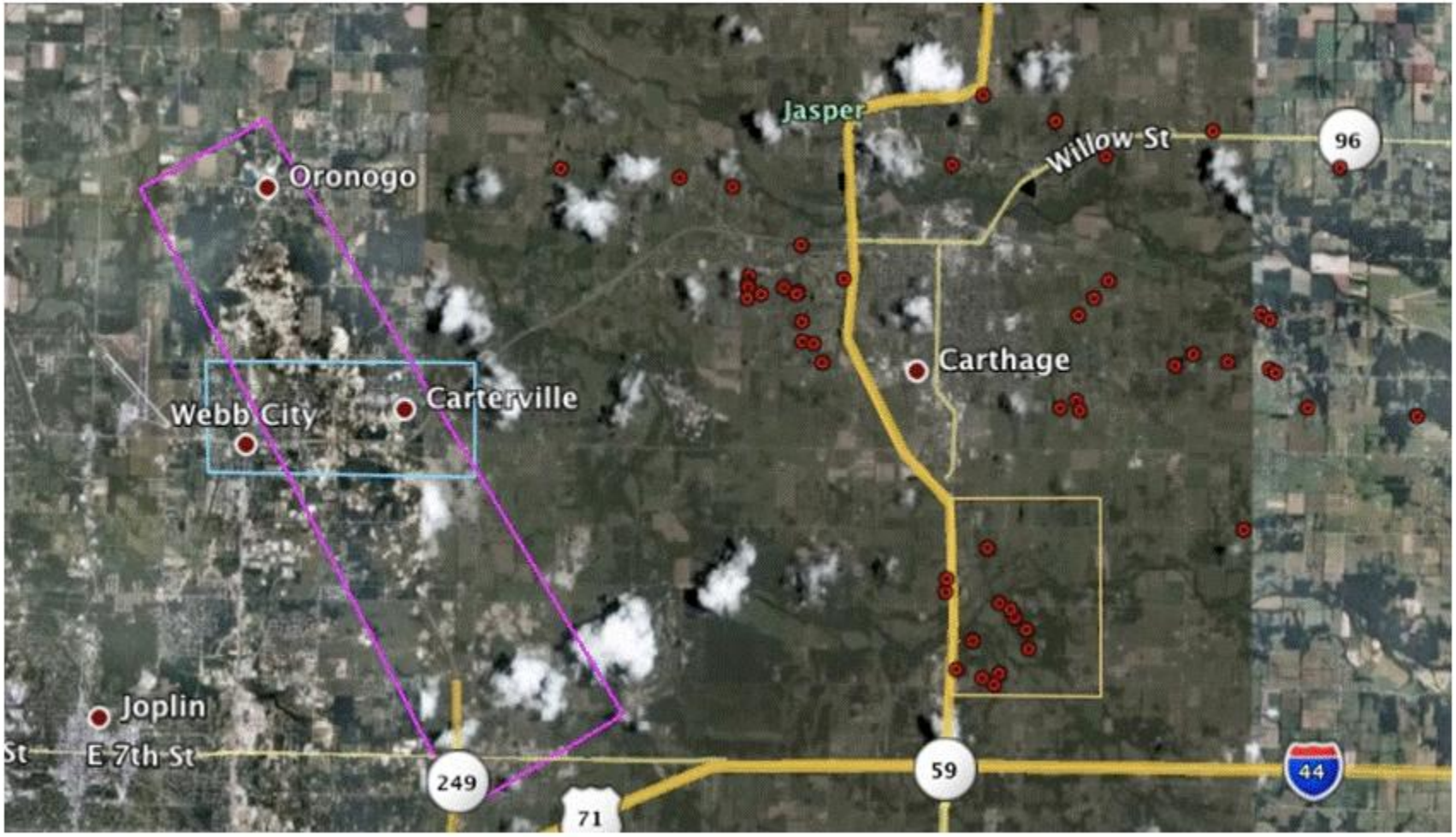
Mine Waste, Residential Contamination & Contaminated Wells



Contaminated wells

ARCHER Boxes (Webb City/Carterville & Carthage South)

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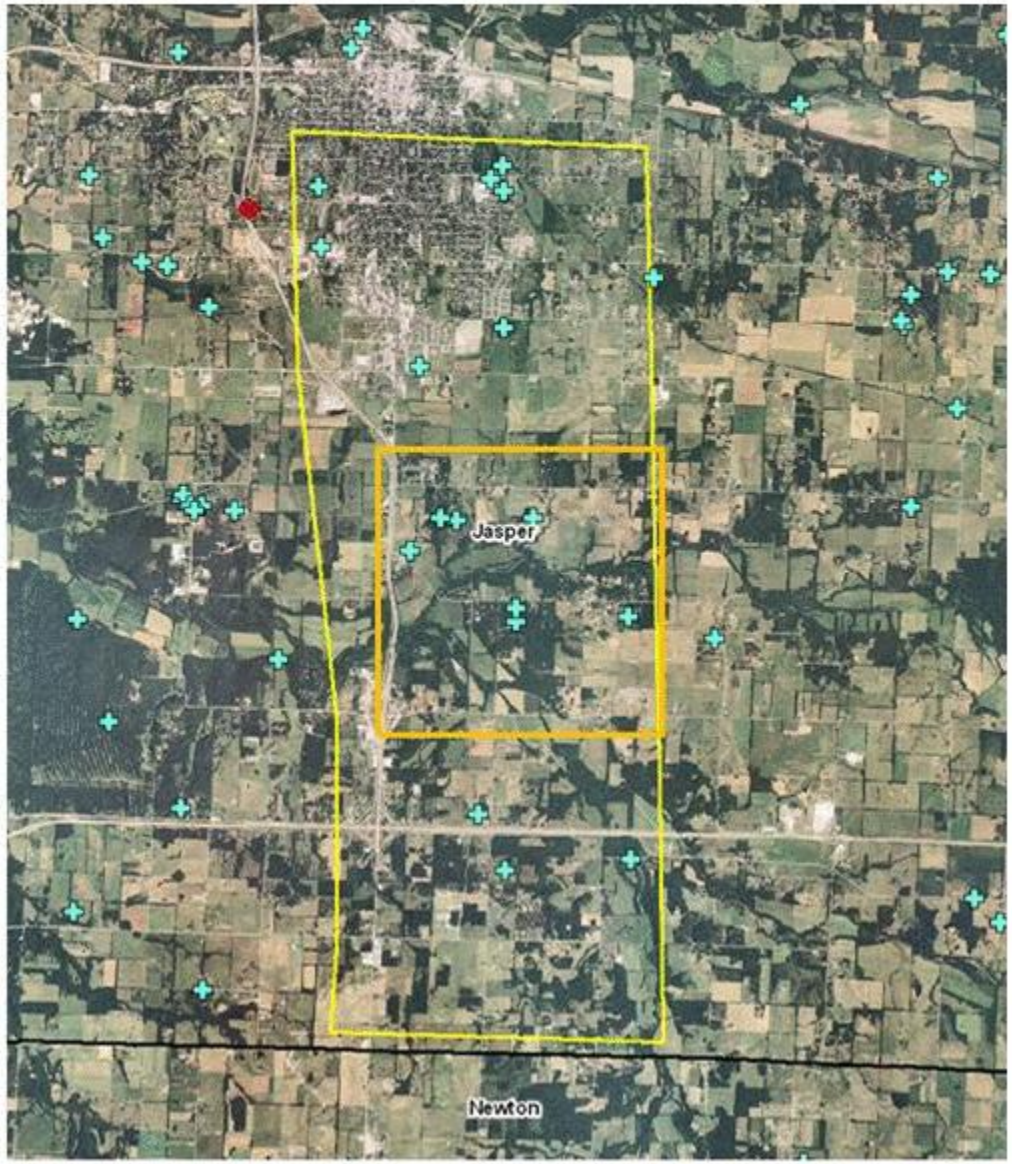
Carthage Area Historic Mines



Historic Zinc Mine Locations

Historic Lead Mine Locations

Carthage Extent

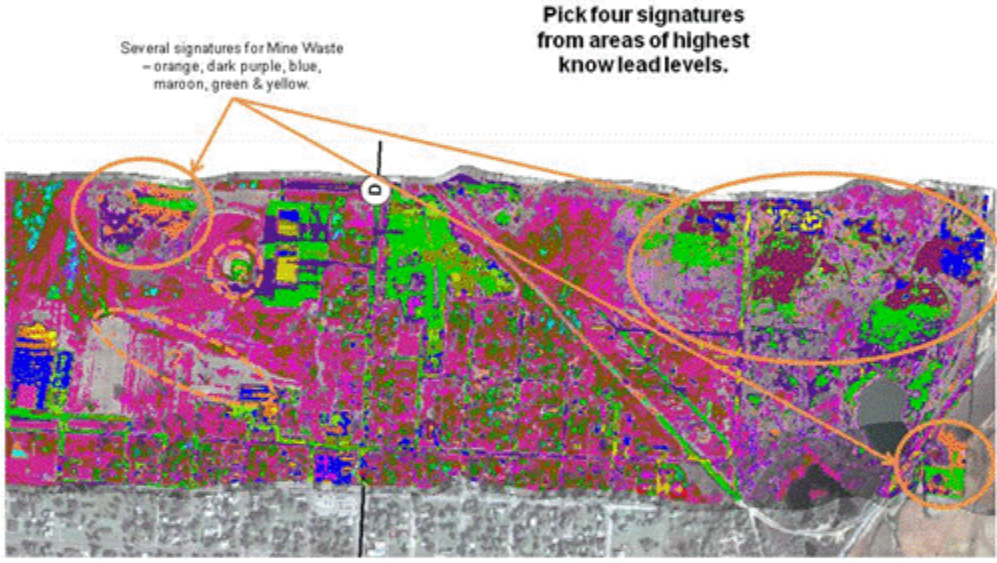
County

jasper_naip07.sid

Missouri Department of Natural Resources

Webb City Endmember

Segment 04



Segment 04

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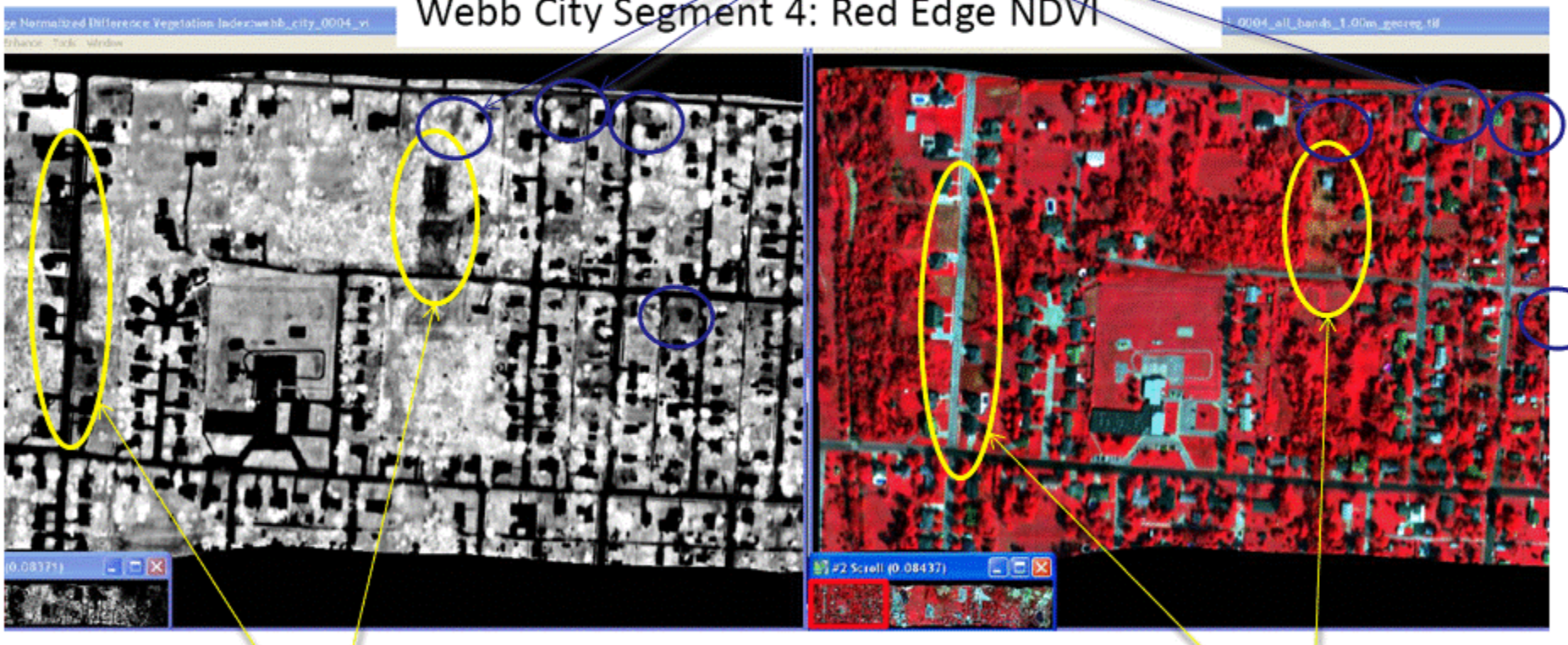
Webb City Vegetation Indices (VI)

Not as easy to spot in false color.



Obvious brown unhealthy grass in false color.

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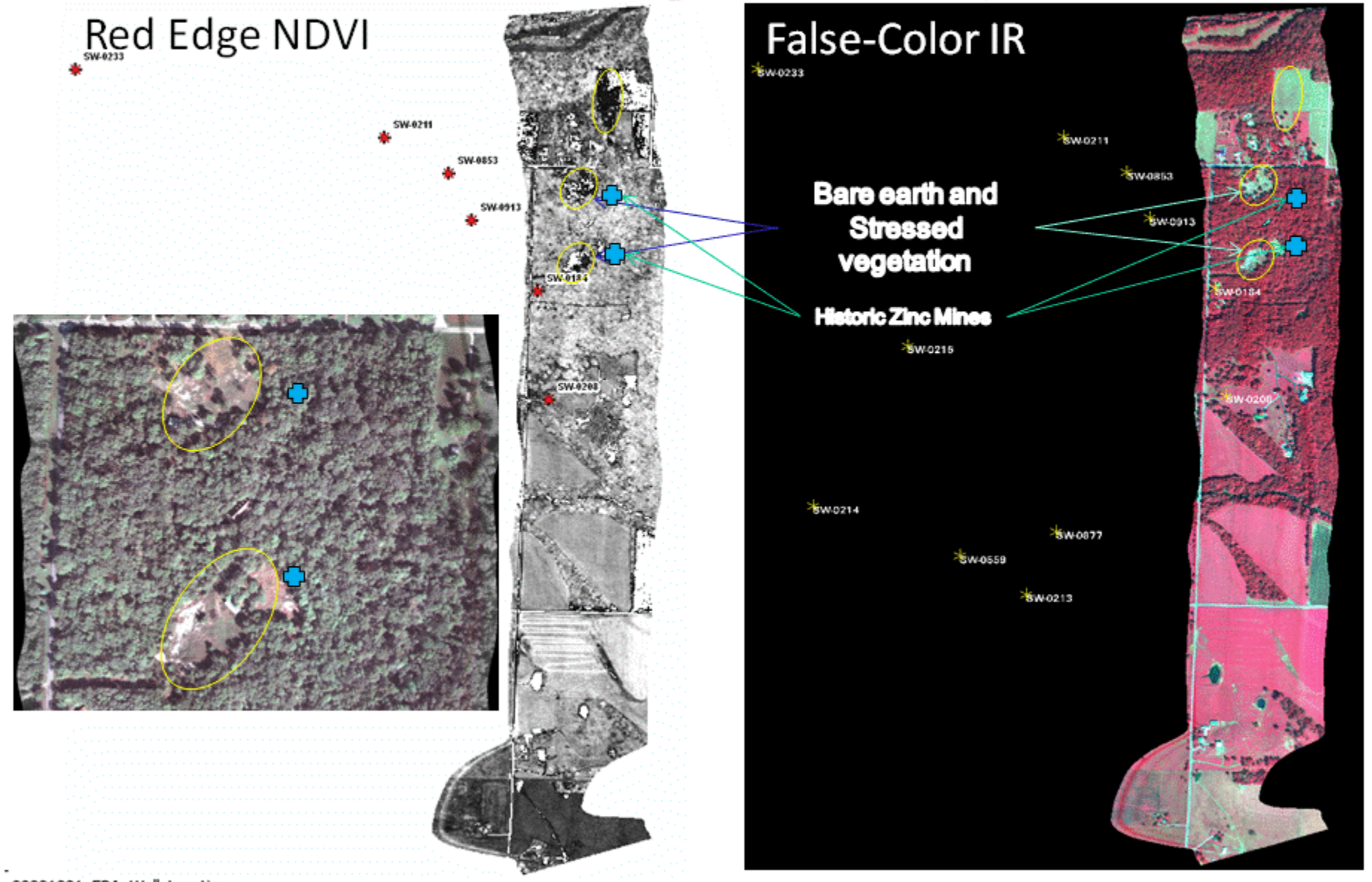
Carthage VI (Red Edge NDVI)

Segment7



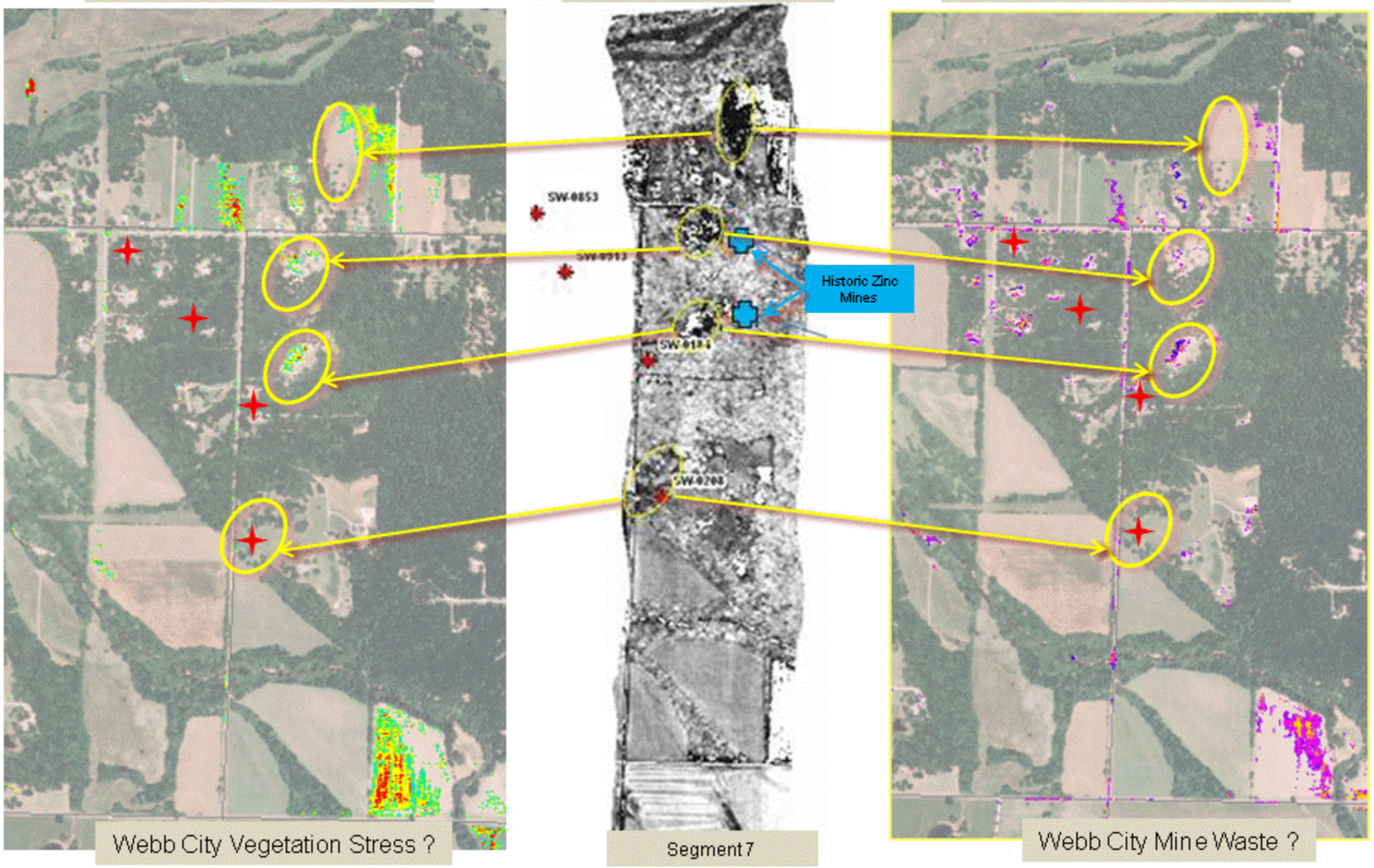
Webb City Spectral Signatures Applied to Carthage Well Contaminated Area

Approximate location of Wells with elevated lead levels0

Spectral Angle Mapper (SAM)

Vegetation Indices (VI)

Spectral Angle Mapper (SAM)



Webb City Vegetation Stress ?

Segment 7

Webb City Mine Waste ?

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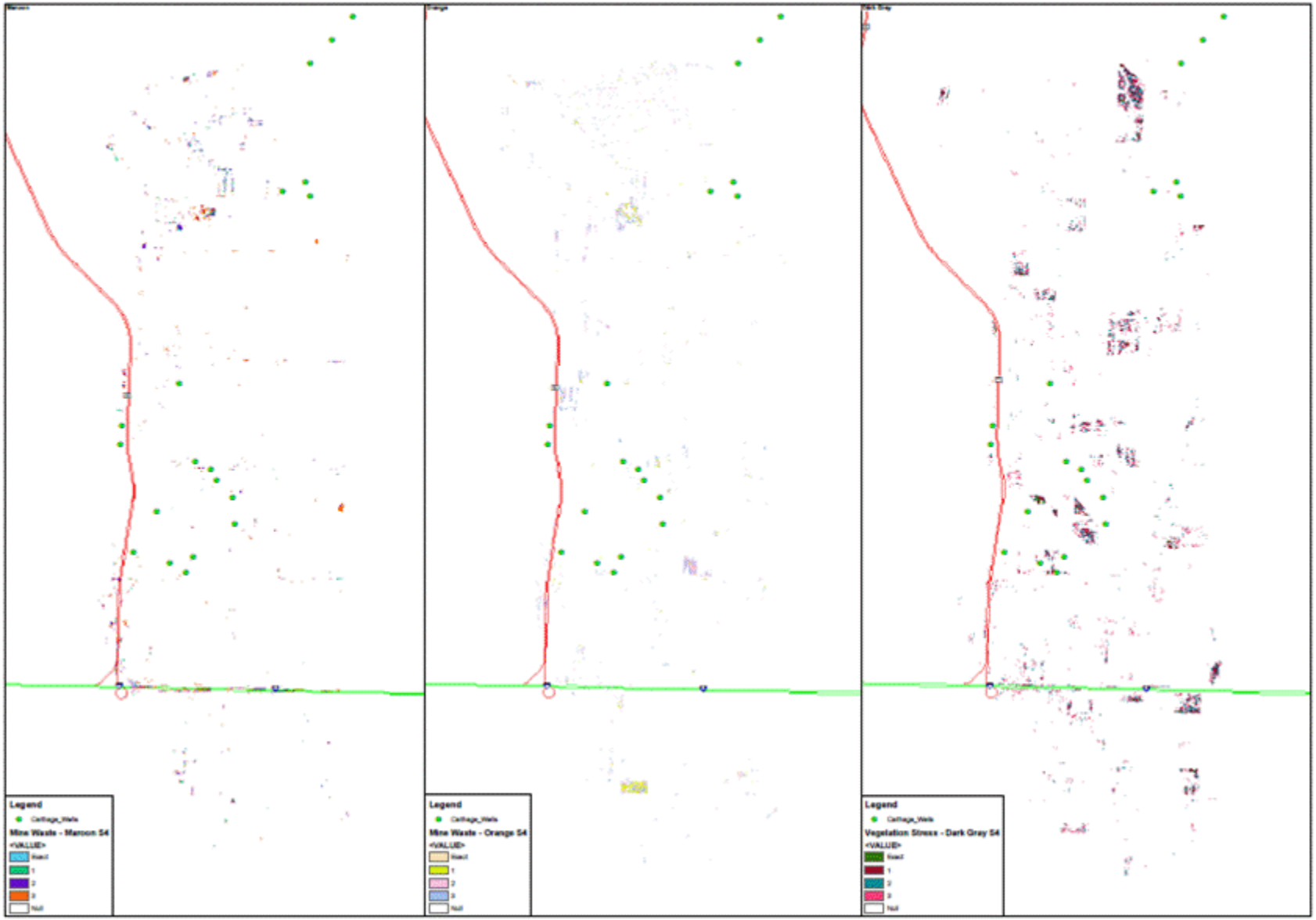
Carthage Contaminated Wells & Webb City Mine Waste & Vegetation SAM Analysis



Carthage SAM Analysis
Segment 4, Signatures Maroon, Orange, Dark Gray
September 26, 2008 Flight

Mine Drainage/Re-vegetation

Tiger Surface & Underground Coal Mining

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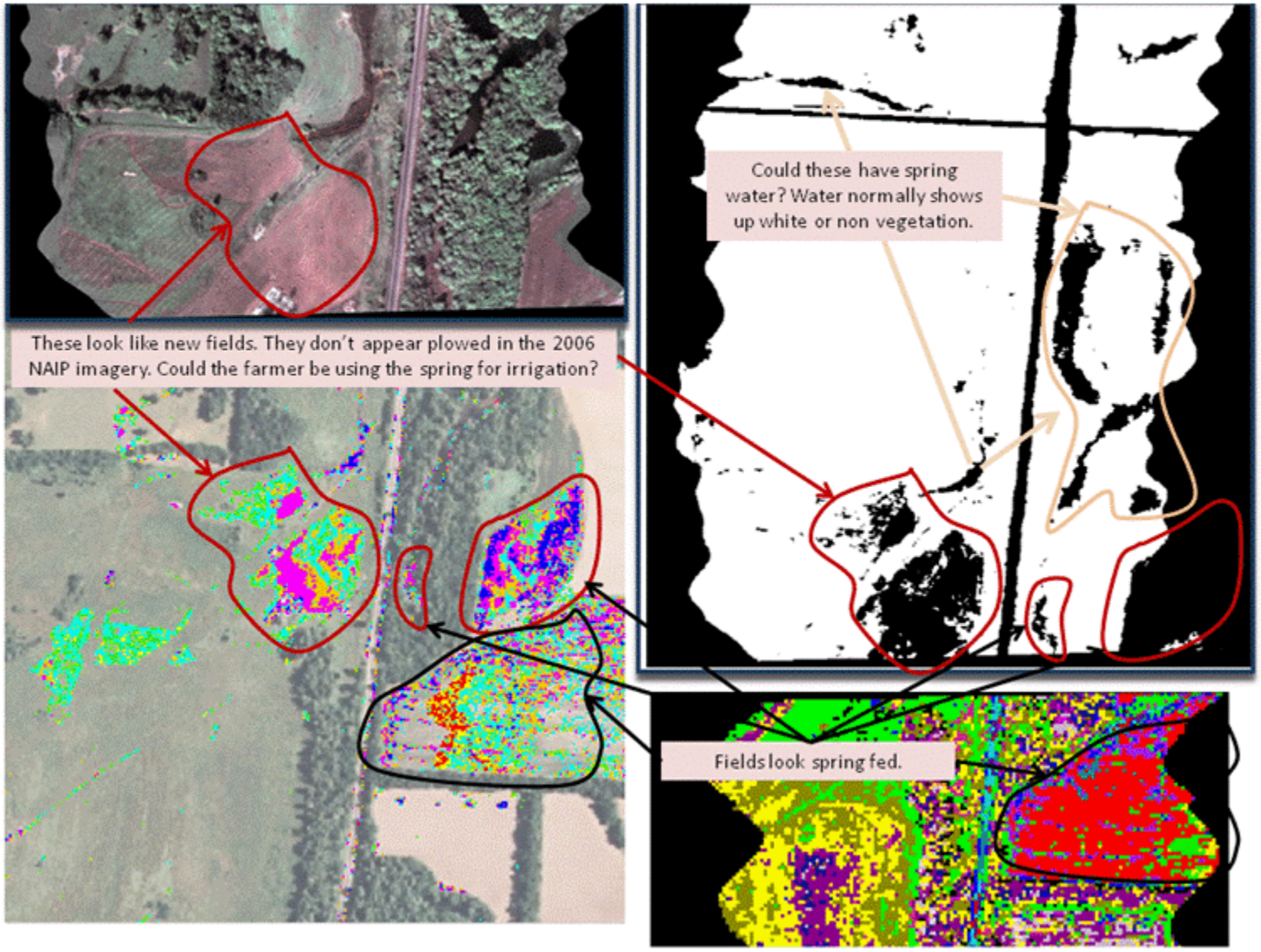
SAM, VI and Endmember Analysis



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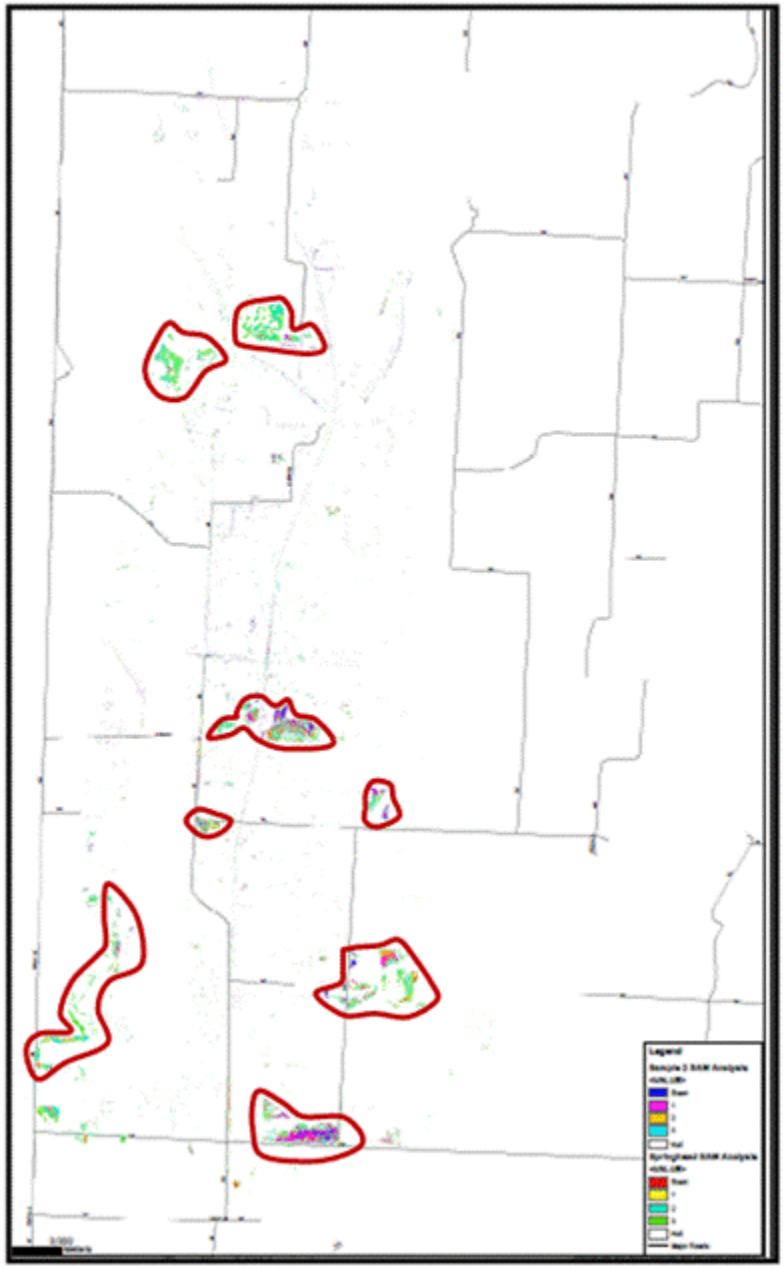
Spring Signatures over Imaged Area

These areas are similar to the spring and nearby fields. Could they also be fed by mine springs?



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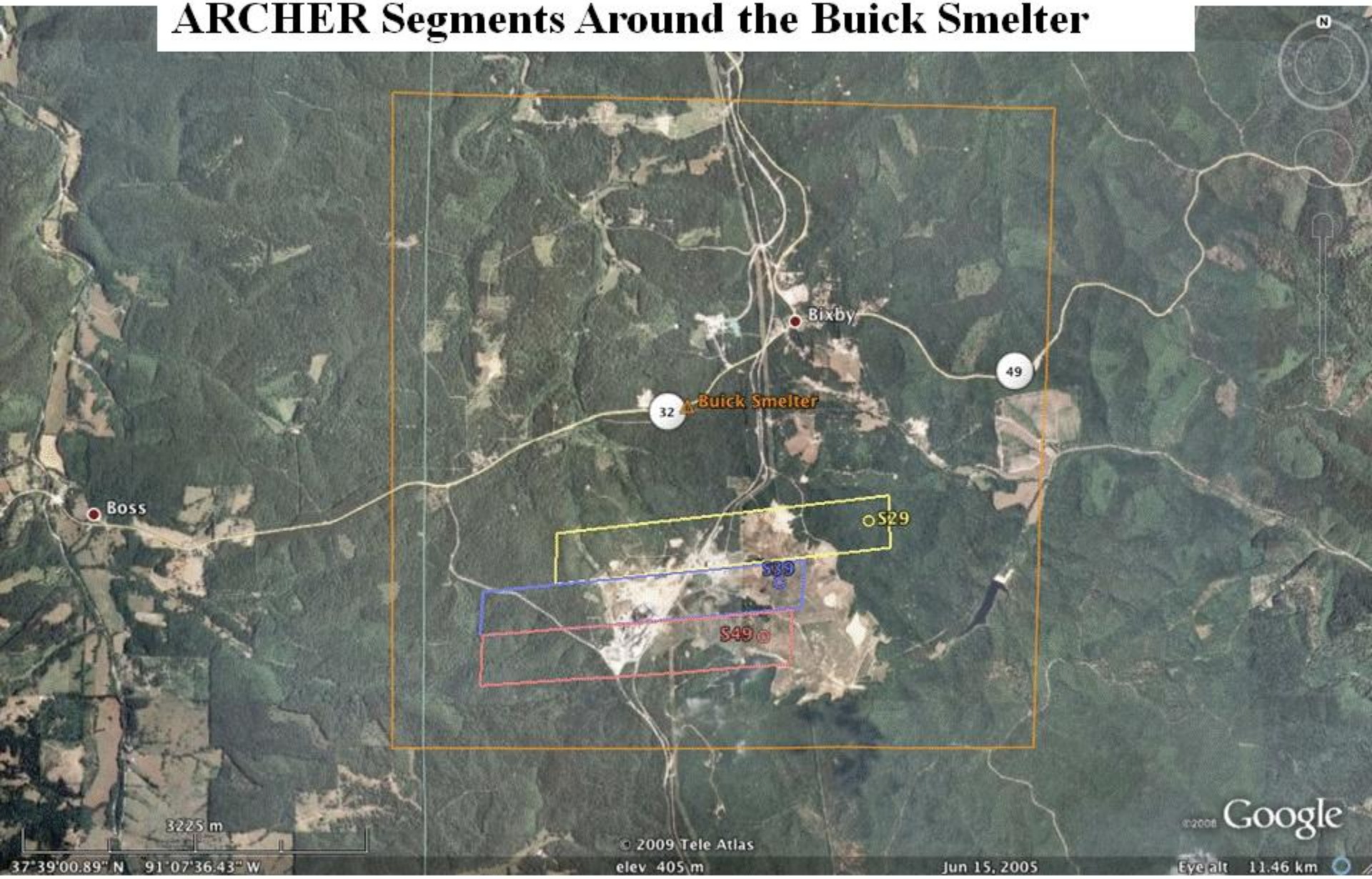
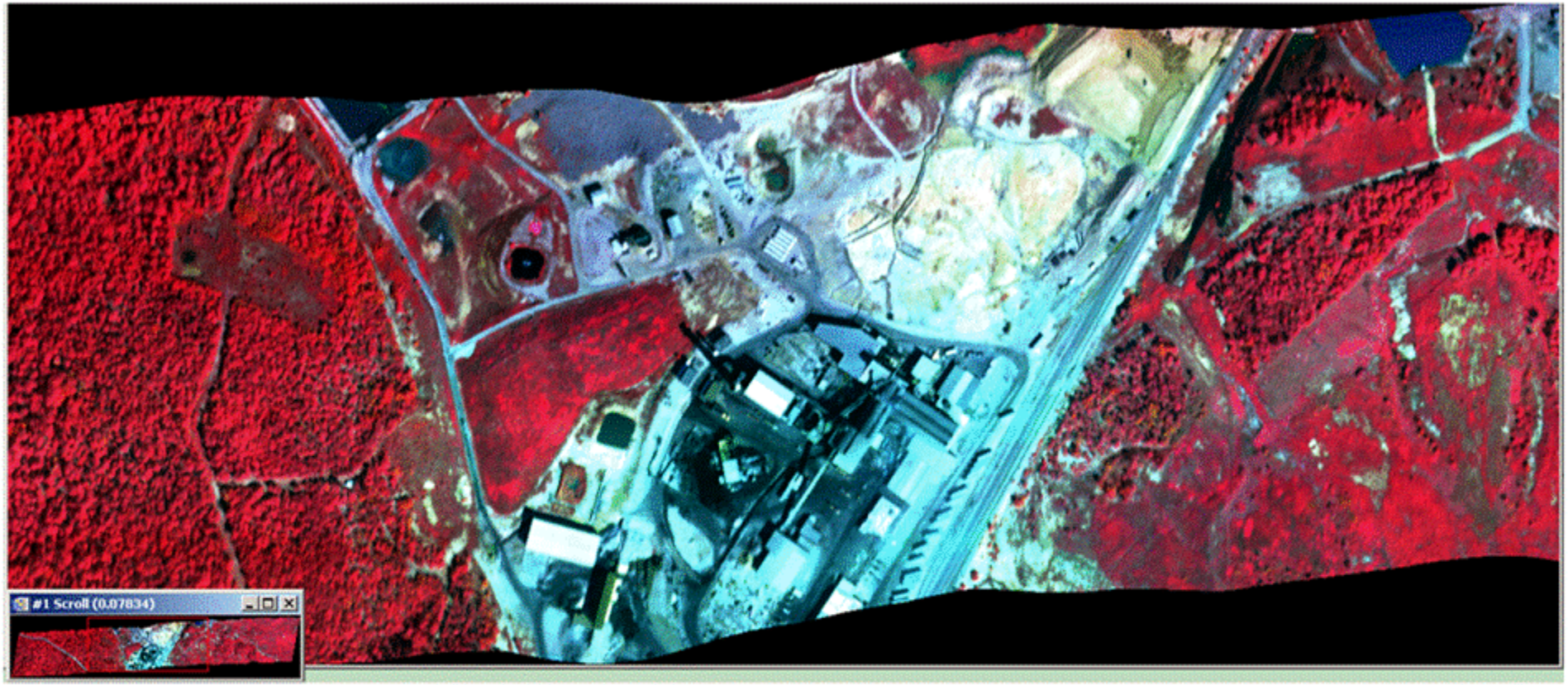
ARCHER Segments Around the Buick Smelter

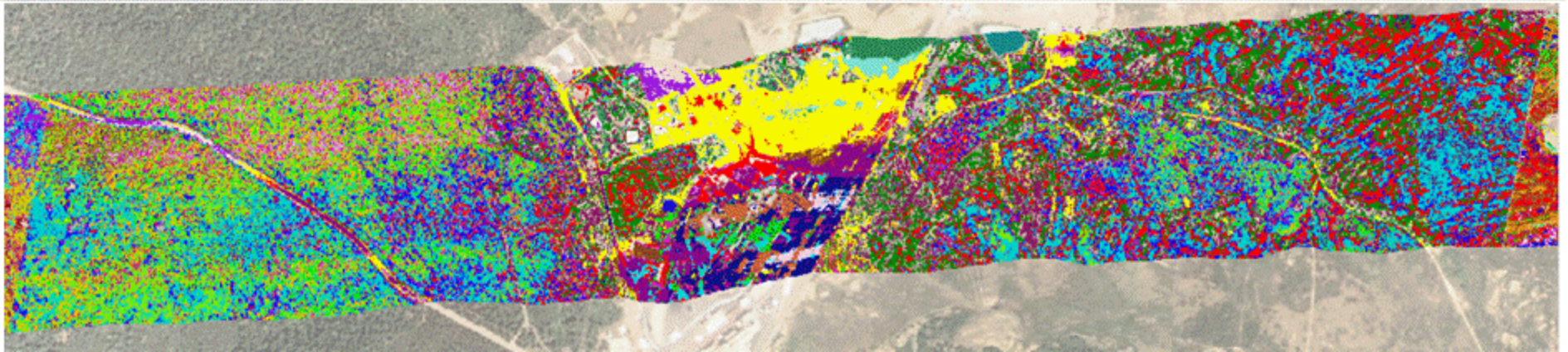


BUICK Segment 29

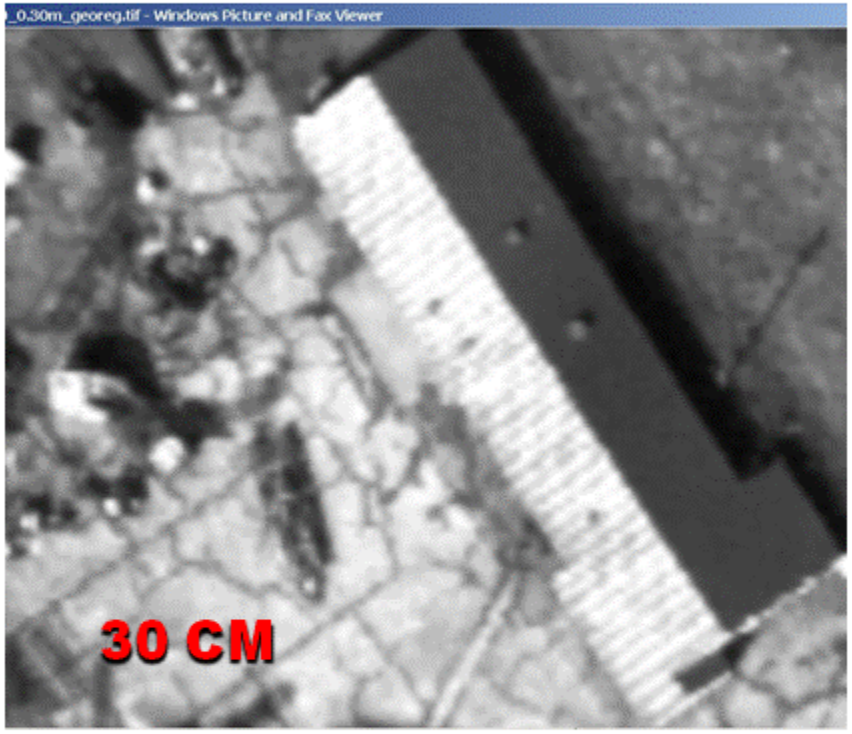
False Color 30,13,3

BUICK Segment 39



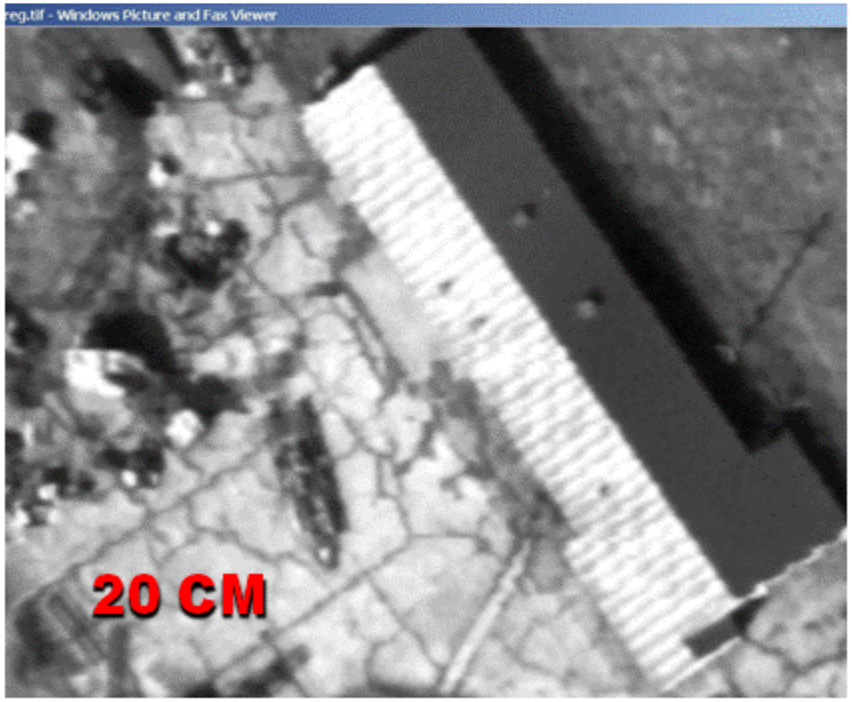


Monitoring Sites



KILO (K-01) LCF

- Monitor covenants for Minuteman II Decommissioned Sites



Questions?